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Sincerely,
EJES, Team

Table of Contents:

A German Innovative Technology Teaching Project in Cooperation Between (Secondary) School, State Seminar and University

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Abstract
"Technology Initiative for NwT (Natural sciences and Technology) school courses" was an innovative teaching project in cooperation between the University of Furtwangen (HFU), the State Seminar for Didactics and Teachers Education Rottweil and the Fürstenberg Gymnasium (FG) Donaueschingen. **The main objectives of this project were the development of teaching units and the implementation of advanced training for NwT-teachers in the fields of process, medical and energy engineering. The ultimate aim is to facilitate a higher level of technology teaching in NwT school courses and in consequence to have more school graduates interested in and suitable for engineering studies.** Between 2012- 2015, 39 technology teaching units were published and 325 teachers took part in 18 workshops. Evaluation of the project showed that many teachers used the training material in class. The hope is that more and improved technical education in school will lead to more engineering students and therefore more engineers in Germany who can fill the current engineer's gap. The project will continue this year focusing on advanced training for teachers as well as the development of further technical and project-oriented teaching material.

Keywords: Technology teaching project, Process Engineering, Medical Engineering, Energy Engineering, HFU (Hochschule Furtwangen/ Furtwangen University)

Introduction: The innovative cooperative teaching project "Technology initiative"

1.1 NwT (Science and Technology) in school and the motivation for this initiative

In 2007 / 2008 the school subject NwT was introduced into all state gymnasia in Baden-Wuerttemberg as a major science subject. Ever since, it is a four-hour core subject in classes 8-10, and in addition, as a trial, selected schools only offer two hours laboratory training per week in classes 11-12 . The basic subjects biology, physics, chemistry and geography form the scientific base and shall be integrated into the new subject NwT. The NwT teachers originally had taught these basic science subjects and now teach NwT, as specific training as a teacher for NwT was not available until 2010 / 2011. The topics in NwT are influenced by the pupils world of experience and thought and, as an integrated discipline, shall be considered from the view of all sciences and technology. Scholastic standards for NwT, available on the official website for teacher training Baden-Württemberg say "Special emphasis is placed on the experimental and project-oriented work within an action-oriented and student-centered education". (Ministry of Education, 2016). The comprehension and realisation of the subject NwT vastly differ from school to school and from teacher to teacher. It ranges from the enjoyment of technology to the gain of complex, technical and engineering, practical and theoretical abilities. The enormous variation in the implementation of NwT partly comes from the subject's sudden introduction and the initial lack of NwT teaching material, in contrast to an abundance of material on individual subjects. The main reason most likely is the teachers' missing technical education, and hence the technology aspect can only be taught in an insufficient way.

The continuing education of teachers in NwT is primarily organized by the regional councils and the website hosts for teachers training. In the beginning, use was made of offers from single schools as well as of highly involved teachers, who expedited elaborations of lessons and made them available. In addition, there was an offer of third party training courses. These were mainly financed by Baden-Wuerttemberg, universities or/and foundations (e.g. NaT-Working-Project, KoScHT-Project, GuT-Project). This cooperation between schools and universities in the field of NwT is of high interest for universities of Applied Sciences, because today's pupils will be tomorrow's students. The school must found the interest in engineering sciences. This can be possible if teachers consider exciting, scientific, realistic and everyday life-oriented topics and teach them in a technical engineering way. The schools should make use of the technical expertise of the universities of Applied Sciences to create a win-win-situation and ultimately to arouse the pupils' interest in engineering.

1.2 Aim, cooperation partners and catalogue of measures

As the title suggests, the aim of the project was to strengthen the technological aspect in NwT lessons by knowledge transfer from the universities to the schools concerning technological topics and approaches.

A cooperation between school-university and the State Seminar for Didactics and Teacher Education was pursued to ensure that all aspects of a technological application-oriented teaching are accounted for. The University of Applied Sciences Furtwangen (HFU) acted as the applicant and the implementing institution (faculty Medical and Life Sciences on the campus Villingen-Schwenningen, in the past known as faculty mechanical engineering and process engineering). Cooperation partners were the State Seminar for Didactics and Teaching Rottweil and the Fürstenberg Gymnasium (secondary school) Donaueschingen.

The Fürstenberg Gymnasium Donaueschingen (FG), a state secondary school, founded in 1778, with currently 1200 pupils and more than 80 teachers, is the central high school for the huge catchment area of the southern Black-Forest-Baar region. (Fürstenberg-Gymnasium, 2016). The FG is famous for its scientific specification, numerous prices at school competitions such as the German youth sciences and technology contest "Jugend forscht" (the FG is the biggest "Jugend forscht" school in Baden-Württemberg since 2007). There is a long-lasting active cooperation between the FG and the HFU, as can be seen in the project "SCHULE meets HOCHSCHULE", which represents an integral part of the study and examination regulations at the HFU. In this project, students establish an experiment to a concrete question. This experiment is then introduced to pupils, who will give the final presentation.

The State Seminar for Didactics and Teaching Rottweil, founded in 1964, assumes, within the teacher training, the training for future high school teachers, meaning the education of student teachers in form of technical meetings. (Staatliches Seminar für Didaktik und Lehrerbildung, 2016). Therefore, the seminar works closely together with the training schools and high schools. The seminar itself imparts teaching methodology, school legislation and pedagogy in the most diverse areas (from math through foreign languages to natural sciences), including NwT.

The University of Applied Sciences Furtwangen (HFU), founded in 1948 in Furtwangen, with its current 6000 students from ten faculties is, as a University for Applied Sciences, very closely interlinked with the local industry and mainly educates students in the field of natural sciences. (Hochschule Furtwangen, 2016). Courses such as Molecular and Technical Medicine, Biological and Process Technology, Medical Engineering and Machine Engineering are offered at the site in Schwenningen. There are courses, in which both the engineering and scientific basis are laid. The focus

rests on an intense practical training, to have professionally qualified graduates. Professors are only appointed, if they can prove years of industrial experiences. The laboratories of the HFU are equipped with state-of-the-art technologies. There are faculties like chemistry, biology and physics, as well as a large technical center and electrical engineering laboratory.

In order to reach the projects aim – the strengthening of the technological aspect in NwT – the following catalogue of measures was set up:

- **Elaboration of lessons** in the fields of process engineering, medical engineering and power engineering as well as their publication on the project's homepage (see 2.1). The decision in favor of the subjects mentioned above was made due to courses with corresponding know-how and laboratories but also due to the fact that, especially in those fields, not enough teaching material was available.
- **Implementation of advanced training courses** for NwT teachers (see 2.2) in the fields of process engineering, medical engineering and power engineering. In this context, the elaborated lessons should serve as a basis.
- **Evaluation of all activities** at the first level (Inquiry: determining satisfaction and where required, readjustments) as well as, according to Kirkpatrick (1994), in combination of third and fourth level (transfer of knowledge into lessons / practical application)

The HFU provided technical knowledge to implement the measures, the State Seminar for Didactics and Teaching Rottweil provided the didactic and the Fürstenberg Gymnasium facilitated the transfer into the school. It was then possible to develop appropriate lessons regarding content and didactics.

In 2011, the project was presented to the Ministry of Science, Art and Culture of Baden-Württemberg at the IQF (Innovation and Quality funds) tender "cooperation models in teaching training" and was approved in the same year.

2. Results from a three years' experience

The project Technology Initiative was provided with 583 230 €from IQF state funds for the entire three years' project period. Alltogether, 2,5 full-time employees worked for the project averaged over three years. They developed 39 elaborations of lessons, including 20 in the area of process engineering, 13 in the area of power engineering and six in the area of medical engineering. 18 advanced training courses were offered in all three areas throughout the entire term (see table 1). In February 2014, the first NwT congress with 171 participating teachers and student teachers took place at the

University of Furtwangen (see table 3).

Topic	Number of lessons	Number of advanced training courses	Number of participants
Process engineering	20	9	173
Power engineering	13	5	79
Medical engineering	6	4	73
Total	**39**	**18**	**325**

Table 1: General overview of the results from the Technology Initiative for NwT lessons showing the total number of elaborated lessons, the total numbers of implemented trainings and the total number of participants (participants in different courses can be the same person).

2.1 Elaboration of lessons

The aim in preparing lessons was to pick up new topics for the practical and technical application of school lessons. The lessons were all structured in the same, recognizable way. They consist of an introduction with theoretical background, a list of the required materials, a development and results section, and the pupils' and teachers' pages with more detailed information and project proposals. The development and results sections deals with topics in a modular and level differentiated way and therefore offers a huge variety for individual lessons. Once a lesson was prepared and tested at the HFU, project teachers were hired who tried out the lessons in school and reworked them didactically. The elaborations are password protected and are available for download from the Technology Initiative's homepage by all those, who request a password. (Technikinitiative NwT. 2016).

2.2 Implementation of advanced training courses for teachers

The advanced training courses are normally one-day-events covering all focal points and pursue a standardized scheme. After the participants had been welcomed, the specialized lecture followed, which introduced the topics power engineering, medical engineering and process engineering and in general, a professor of the HFU held the lecture. Afterwards, the project team members introduced the specific teaching contents, presented the agenda of the day and divided the participants into groups. A large part of the day was spent in the laboratory implementing experimental lessons. These lessons, elaborated by the project itself (see figure 1, 2, 3), were compiled for each training in a meaningful manner and quantity. Each participant implemented an average of 2-4 lessons per training day (see table 2). The high percentage

of the practical part was explicitly requested, as NwT shall be taught in school in an experimental way. The personal experience gained from the training enables the teacher to use it in school. The training day ended with a concluding discussing, including feedback and evaluation of the training course.

Topics	Number of participants			Amount of participants	Amount of implemented lessons *
	2012	2013	2014		
Process engineering	100	42	31	173	**468**
Power engineering		20	59	79	**195**
Medical engineering			73	73	**146**
Total	**100**	**62**	**163**	**325**	**809**

(* Usually, a participant carried out several tests per seminar.)

Table 2: Advanced training courses of the Technology Initiative. Number of advanced training courses with the amount of participants and total sum of implemented experimental units, listed thematically and chronologically.

There was great interest in the courses offered (table 2). The teachers came from all parts of Baden-Wuerttemberg. Overall, the participants represented 30% of Baden-Wuerttemberg's high schools (112 high schools of a total of 378) Regional Council Stuttgart, Department 71. (2016, January 21). Retrieved from https://rp.baden-wuerttemberg.de/Themen/Bildung/Eltern/Bildungswege/Seiten/Allgemein-bildendes-Gymnasium.aspx).

2.3 First NwT Congress at the University of Furtwangen

On 24 February 2014, the first NwT Congress was held at the University of Furtwangen including high-ranking politicians and education experts. It served as a platform for a professional exchange between all NwT contributors. Minister for education Stoch inaugurated the Congress, which was visited very frequently by approximately 200 teachers and student teachers. Prof. Dr. Nickolaus from the University of Stuttgart gave the key note lecture entitled "Effects of methodological decisions on the motivational and competence development in technical lessons". A NwT exhibition, advanced training courses in NwT and a lecture serie on different aspects of NwT accompanied the Congress (see table 3).

8 advanced trainings / workshops	7 lectures
Power engineering	"Generis of NwT " G. Stern,
Medical engineering	"Understanding medical engineering" R. Frank
Energy village	"Didactic model for planning and optimizing NwT lessons", P. Geiger, Dr. F. Haag , T. Kreß
Creative-technical 3D-workshop	
Researching, project oriented lessons based on the example „water wheel"	"Production engineering in NwT", Prof. Dr.-Ing. M. Plank
Process engineering based on the example of apple juice production	"Technology for pupils and teachers", Prof. Dr.-Ing. H. von Eiff
Sun lotion – an emulsion with protection factor	"Escape the ivory tower – NwT projects with cooperation partners outside school", M. Mosbacher
Working with CAD based on the example SketchUp	"A didactive model for NwT lessons till course level", R. Kügele

Table 3: Content overview of NwT Congress on 24 February 2014 at the University of Furtwangen. Very informative and inspiring presentations could be offered due to the participation of the Esslingen University of Applied Sciences, the State Seminar for Didactics and Teacher Education Rottweil / Esslingen and Freiburg, the Fürstenberg Gymnasium, the company TECVEST and the Federal Government of Bavaria.

3 Evaluation of all activities
3.1 Evaluation results of the advanced training courses

The participants evaluated all advanced training courses before (query of expectations in a-part of figures) and after (query of satisfaction in b-part of figures) the event (see figure 1, 2). These are evaluations of the first level according to Kirkpatrick (1994). The success of the event was thereby reviewed. Constructive discussions assured the appropriate adaption and advancement of the training, of the topics worked on as well as of the lessons. [1]

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1 Discrepancies between the overall sum of participants and the sum of following answers come off by the fact that at the beginning of the project 70 participating student teachers could not be included in the evaluation due to incomparable data sets.
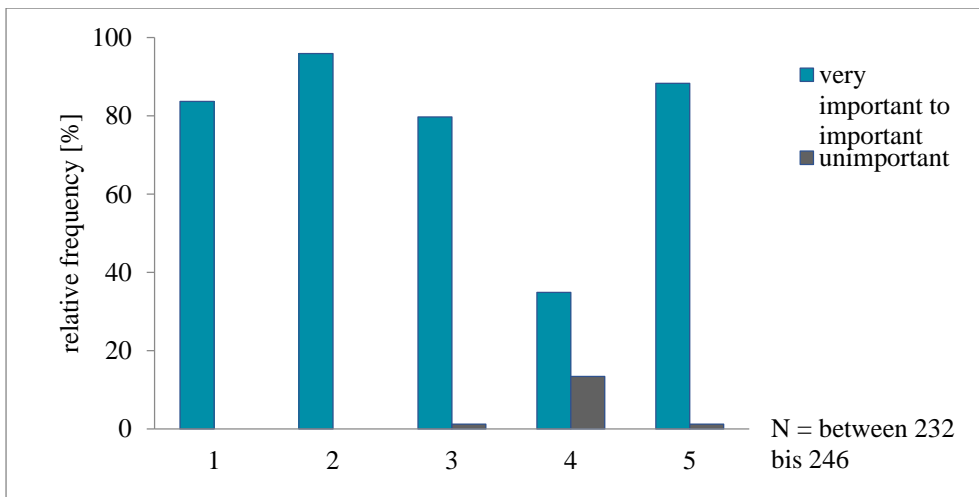
Figure 1a: Expectations on the advanced training courses. Relative frequency of the mention of the categories "very important" and "important" as well as the category "unimportant" within five possible assessment categories: 1 – professional training (201 out of 246), 2 – approaches on project oriented lessons (230 out of 240), 3 – finished material (192 out of 241), 4 – approaches on "Jugend forscht" (81 out of 232), 5 – suggestions for the transfer of technical implementations (213 out of 241). The expectations were inquired prior to the advanced training course.
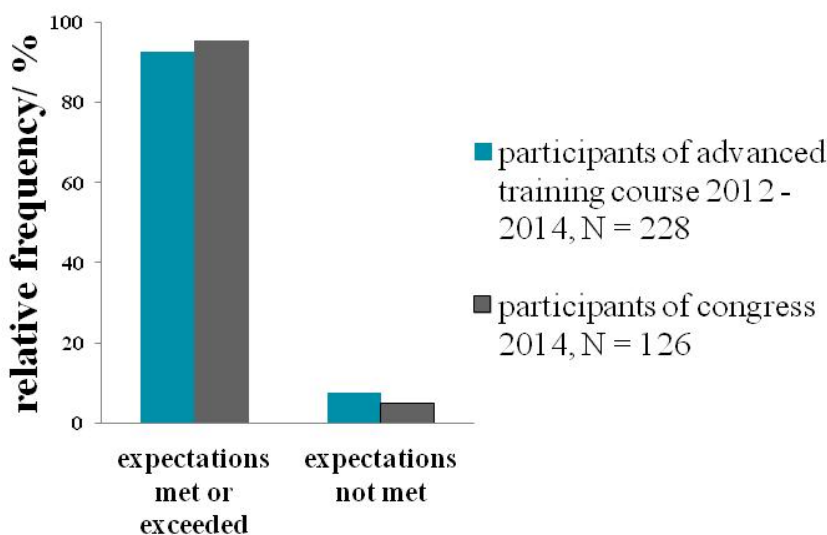

Figure 1b: Evaluation of the advanced training courses. Relative frequency of the mention of the categories "expectations exceeded" and "expectations met" (seminary: 211 out of 228, congress: 120 out of 126) as well as the category "expectations not met". The participants were inquired at the end of the course.

Figure 1a illustrates the participants' expectations on the advanced training courses. The categories (1) professional training with 83.7%, (2) approaches on project-oriented lessons with 95.8%, (3) finished material with 79.9%, (4) approaches on "Jugend forscht" with 39.9% and (5) suggestions for the transfer of technical implementations with 88.3% were evaluated as "very important" to "important". It is remarkable that the teachers evaluated the (4) approaches on "Jugend forscht" with 13.4% (31 out of 232) as "unimportant". In contrast, figure 1b shows the participants satisfaction on all seminaries and the NwT congress. The expectations of 93 % of the participants of all seminaries were met or exceeded; the expectations of 95 % of the participants of the congress were met or exceeded.

The alignment of the expectations regarding the advanced training courses and the great satisfaction allow for the conclusion that at least the categories queried, such as professional training, project-oriented work, finished material and transfer of technical knowledge could be realized and fulfilled with great success. All three focal points could fulfill the expectations to nearly the same extent. The percentual satisfaction was around 97% on the topic process engineering (72 out of 74), around 88% for seminaries on medical engineering (56 out of 64) and around 92% for the trainings on power engineering (69 out of 75) (data available but not listed here).
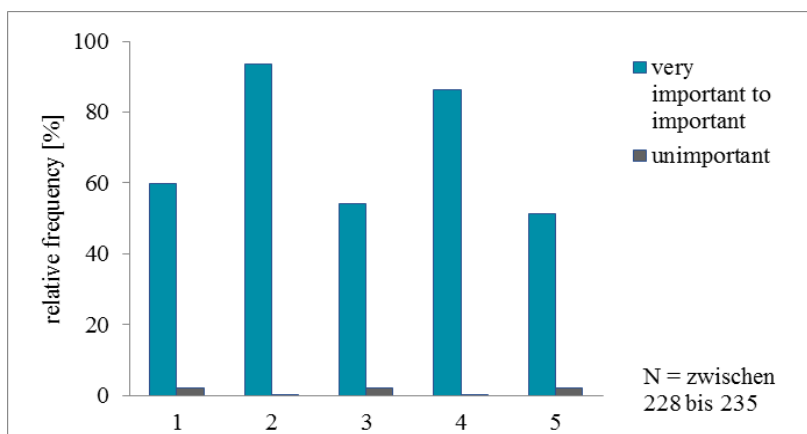
Figure 2a: Expectations on the teaching material. Relative frequency of the mention of the categories „very important" and „important" as well as „unimportant" within five possible assessment categories. 1 – level differences (139 out of 232), 2 – project-oriented (220 out of 235), 3 – complete educational section (126 out of 233), 4 – educational components (201 out of 233), 5 – preferred open questioning (169 out of 228). The expectations on the teaching materials were inquired prior to the advanced training courses.
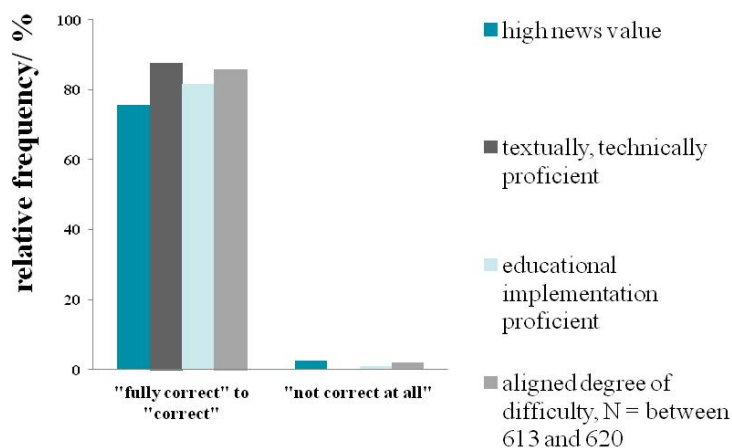
Figure 2b: Evaluation of the teaching material. Relative frequency of the mention of the categories "fully correct" and "correct" as well as "not correct at all" within five assessment categories. The participants were inquired at the end of the courses.

Figure 2a illustrates the participants' expectations on the available teaching material. The presence of the following criteria for the teaching material was evaluated from "very important" to "important": (1) level differences with 59.9%, (2) project-oriented with 93.6%, (3) complete educational section with 54%, (4) educational components with 86,2% and (5) preferred open questioning with 51.3%. Figure 2b summarizes the query of the satisfaction with the Technology Initiative's teaching material. The teaching material was confirmed as "fully correct" and "correct" in regards to high news value (75.5%, 468 out of 620), textually, technically proficient (87.6%, 539 out of 615), proficient educational implementation (81.7%, 503 out of 616) as well as aligned degree of difficulty (85.9%, 526 out of 613). The increased number of answers is attributed to the fact that in average three lessons were carried out and evaluated by the participants in each seminar.
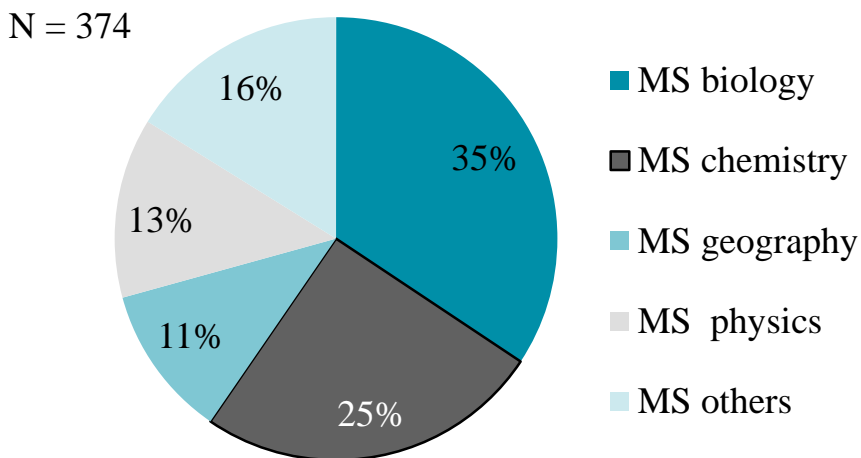
N = 374

Pie chart segments: MS biology 35%, MS chemistry 25%, MS geography 11%, MS physics 13%, MS others 16%.

Figure 3: Subjects of the participating teachers (seminars and congress).   Participants (only 243 of the 325 participants total) were asked about their qualification to teach a particular subject (MS, main subject), each teacher has the qualification to teach two, sometimes three subjects, given numbers of subjects per participant were 1-3. (N = mentioned subjects N = 374)

As a result of the given information about the participant's subjects, biology was the most frequent main subject of the participants (35%, 129 out of 374), followed by the main subjects chemistry (25%, 95 out of 374), physics (13%, 49 out of 374) and geography (11%, 40 out of 374). When interning this total result according to the focuses, a slight shift between the process engineering (PrE), medical engineering (ME) and power engineering (PE) seminaries can be seen: between 30-40% of the participants stated to have biology as their main subject. Between 23-28% stated to have chosen physics and between 9-12% have chosen geography as their main subject (PrE N = 155, PE N = 114, ME N = 105, data available but not listed here). The following tendencies can be recognized: biologists prefer ME-seminaries, whereas physicists prefer PE-seminaries.

3.2 Evaluation results of the online survey evaluation

In a further evaluation step, according to Kirkpatrick, the third and fourth assessment levels were interconnected (Kirkpatrick et al 1998). On the one hand, the popularity of the Technology Initiative's actions was verified, as well as the applications of knowledge gained from the advanced training courses and the usage of the project lessons (table 5 and 6). On the other

hand, the conclusions resulting from the practical application were collected and utilized. The conclusions were the result of detailed feedback, mainly through the project managers. The evaluation took place in consequence of an online survey 28 January 2015 via homepage and a mailing campaign (involving all participants of training courses and the congress as well as additional contacts). The recovery rate of this survey was 80/350.

Topic of lesson	Known lessons (only lessons, on which advanced training courses were offered)/ %	Known lessons (lessons where training courses were offered AND lessons that were only on the homepage without training courses offered)/ %
PrE	78.9	57.0
PE	56.2	47.9
ME	68.7	62.8

Table 4: Lessons' popularity, split into topics process engineering (PrE), power engineering (PE) and medical engineering (ME). The participants of all advanced training courses were inquired via online survey in January 2015 (N = 80/350). 100% = all lessons of the Technology Initiative are known.

Table 4 illustrates that 56% (145 out of 258) of the respondents were familiar with the Technology Initiative lessons about power engineering that were offered in the seminars. 69% (103 out of 150) were familiar with lessons about medical engineering and 79% (194 out of 246) were familiar with process engineering. The familiarity of all lessons, including those without further education offered, was, as expected, approximately 6-22% lower. This leads to the conclusion that the degree of familiarity of the project's lessons can be increased through their implementation in advanced training courses. On average, the evaluating teachers were familiar with a little more than 50% (48-63%) of all available lessons of the Technology Initiative. It would be interesting to pursue the familiarity of the lessons over the years.

Topic of lesson	Numbers of all lessons used in school
PrE	114
PE	60
ME	14

Table 5: Application of the projects' lessons in school divided into the topics process engineering (PrE), power engineering (PE) and medical engineering (ME). The participants of all advanced training courses were inquired via an online survey in January 2015 (N = 80/350).

Table 5 outlines the absolute frequency of use of the lessons, itemized by focuses. The familiarity and most of all the frequency of use reflects the fact that the training courses corresponding to the focuses were introduced yearly; that is process engineering in 2012, power engineering in 2013 and medical engineering in 2014.
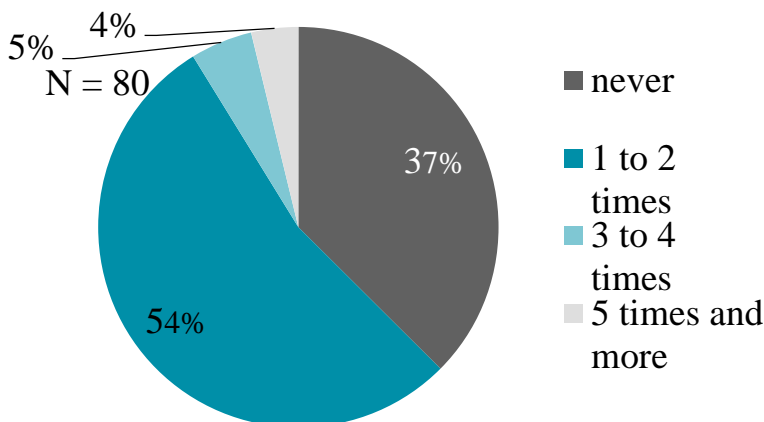

Figure 4: Frequency of use of the lesson's practical application in school. The participants of all advanced training courses were inquired via an online survey in January 2015 (N = 80/350).

Figure 4 illustrates that 63% (50 out of 80) of the respondents used lessons of the Technology Initiative for at least one time, in comparison to 37% (30 out of 80) who never used material of the Technology Initiative. This high percentage of practical application in class shows above all the usability of the lessons created by the project as a valuable tool for teachers of NwT.

4 Conclusion of the project and outlook

The project Technology Initiative for NwT school courses started three years ago to transfer the technological knowhow from the University of Applied Sciences to schools. New, practical and significant social topics from the engineering sciences should be prepared textually and didactically for school lessons. A hitherto not existing bridge between the school, the university and the State Seminar for Didactics and Teacher Education was built to meet the high technical, didactical and application-oriented requirements.

4.1 Conclusion of the project "Technology Initiative for NwT school courses"

At the end of the three years funding a throughout positive result can be see. The evaluation results demonstrate that the advanced training courses as well as the elaborated teaching materials comply with the requirements of

the teachers (see figure 1 and 2). The Technology Initiative is especially satisfied with the fact that the elaboration of the Technology Initiative covers requirements, such as "project orientation" or "level differentiation". With these results, the teaching materials and advanced training courses are in line with the present trend of the current didactic for the NwT school course, which intensely emphasizes project-oriented work.

A wide network of all NwT participants was created in these three years: due to the variety of activities offered (table 2), the NwT congress (table 3), the direct exchange with the teachers, the multiple dialogues with subject specialists, the Technology Initative's homepage (www.technikinitiative-nwt.de) , the data acquisition and the maintenance of the schools and teachers – and not least by the intense exchange with the cooperation partners, the Seminar Rottweil and the Fürstenberg Gymnasium. The requested textual diversity and freedom, paired with various requirements for NwT school courses at the schools call for a broad network. This is to be able to offer diverse and profound content and material and therefore, to achieve a broad, sustainable acceptance among NwT teachers.

After almost eight years of existence, the NwT course sees itself confronted with undergoing changes. Project-oriented lesson sequences, which shall build on one another through grade levels, and the definition of concrete competencies become a focus in NwT courses.

The new education plan is valid now (from 2016 on) and is to be realized in NwT courses in 2018. It shall initiate further development of NwT courses as well as a specific didactic orientation of NwT lessons (personal correspondence with the experts on the education plan Rainer Kügele and Alexander Schäfer).

The teaching method of project-oriented lessons is not new, especially not at universities. Already at the beginning, the pedagogy of the 20th century of John Dewey and William Heard Kilpatrick showed the way forward for projects in science lessons (Dewey and Kilpatrick, 1935). Over the next century, there were numerous adherents of this teaching method, which, above all, emphasizes the problem-solving, interdisciplinary and product-oriented character of the project's concept.

This stands in contrast to studies, which show that didactic methods (e.g. experimental teaching vs. teacher-centered teaching) barely affect the technical affinity or no general assumptions on the impact can be made. Furthermore, big differences in the results of the surveys occurred according to the subject matter, e.g. between natural sciences and technology. Nickolaus (2014) generally states that most of all the quality of the setting defines the learning success. Hattie's big meta-study revealed that the main factor for successful learning is awarded to the teacher, not to the teaching method (Hattie, 2008). According to Hattie, the big majority of new

pedagogical approaches ("open education", "discovery learning", "web-based teaching") has barely any influence on the educational success. "Feedback" (in both directions) is one of the most important factors for successful lessons. Hattie states that the clarity of requirements, regular performance review, teacher-led lessons, additional offers for strong and weak pupils, problem-solving lessons, subject-specific teacher trainings etc. are central modules of successful learning. The demand on the technical lessons Hattie extracted are, like the present survey of the teachers show, still current (figure 2). Especially project-oriented, technical lessons and their didactical realization against the background of several restrictions (such as gaps in training, lack of time and gaps in equipment) will pose various, enormous challenges for NwT teachers in the future.

4.2 Continuation of the project in 2015 and 2016 as version 2.0

Since 2015, the project Technology Initiative for school courses, now as version 2.0, continues with financial support from the University of Furtwangen and the training institute Südwestmetall as well as funding from the chemical industry in 2016.

New measures of the follow-up project set the focus on multi-day, deepened and interrelated teacher training based on one special field (PrE, ME or PE) as the threshold of using the lessons in class is still too high for about 1/3 (37 % see figure 4) of the participants. It could be lowered through theoretical and practical training courses.

The lessons and components of the advanced training courses are further on available as online versions. Not just the lessons are available as download, but also parts of the advanced training courses, in terms of blended-learning-events, are on offer on the homepage.

Another focus lies on the strengthened project orientation of the advanced training courses, which now begin with a learning circle, lasting several days, and end with a project of the teachers. The teachers are hereby supported in qualifying the pupils for a topic and on this basis to develop a project within an open questioning independently. The Technology Initiative 2.0 is therefore oriented towards the developed didactic-pedagogic concepts for NwT school courses as well as towards the new education plan, published in 2016.

A new feature of the Technology Initiative 2.0 is also to provide modules and teacher training up to classes 11-12. It will only succeed in arousing enthusiasm for engineering sciences if an integrated NwT concepts exists at a school throughout the complete schooldays. Therefore, the number of schools, which offer NwT in class 11-12 (currently 10%, this corresponds to 40 high schools in Baden-Wuerttemberg) shall be significantly increased in the next few years so that a comprehensive offer is generated (Personal

dialogue with Alexander Schäfer, regional council Stuttgart). For this purpose, appropriate teaching material needs to be developed and teachers, who are able to offer established specialized classes, need to receive further education. The aim is to contribute constructively to achieve the big long-term goal of NwT becoming an exam subject of the centralized A-level. These graduates with strong interest in engineering and a funded scientific-orientated background are valuable engineering students and will fill the engineers' gap in Germany in future.

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Overweight and Obese College Students' Perceived Barriers and Motivators for a Healthy Lifestyle

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Abstract

        This qualitative study explored overweight and obese college students' experiences of obesity. Overweight and obese university students (BMI 25 or higher) from a southwestern regional university in the United States were recruited for in-depth qualitative interviews. Interviews were conducted face-to-face in a private room during the academic year 2013-14. A team of trained qualitative researchers used conversational interviews to discuss the students' experiences for 45-60 minutes. Interviews were audio-recorded and transcribed. Data analysis used qualitative emergent themes and categorization. Researchers analyzed the data at team meetings for triangulation and validation. Nineteen overweight or obese university students (female=11 and male=8) participated in the study. Sixty-three percent (12 out of 19) were obese and the remainder were overweight. Seventy-three percent (14 out of 19) did not meet the physical activity guidelines for Americans. Time and motivation were barriers for physical activity. Seventy-three percent (14 out of 19) reported eating unhealthy foods. Lack of time and convenience were barriers to eating healthier. They showed a lack of knowledge on how to make healthy food choices. Eleven out of nineteen (57%) participants were self-conscious about their body, and half were having trouble finding clothes that fit. These results support the previous literature on psychological issues, lack of daily physical activity,

and lack of a healthy diet. This suggests that health promotion is needed for college students to foster healthier lifestyles.

Introduction
    Obesity is a worldwide health problem that has continuously increased in the last 33 years (Ogden et al., 2006). According to the Center for Disease Control, 69% of Americans age 20 or older are overweight or obese (Ogden et al.*,* 2014). In previous research, about two-thirds (66%) of college students surveyed at a southwestern regional university were also overweight or obese (Oh, Boss, & Lopez, 2014). Overweight and obese adults have negative experiences including discrimination, bullying, teasing, and social isolation (Thomas et al., 2007). This causes self-consciousness and body dissatisfaction (Sarwer, Thompson, & Cash, 2005).
    Research has shown that the majority of overweight or obese people have already experienced some type of negative experience in their childhood that usually continues through adulthood causing psychological issues: self-consciousness, attitude, and body dissatisfaction (Thomas et al., 2008). Based on a survey study published in Psychology Today, half of males and two-thirds of females have reported to be dissatisfied with their bodies and body weight; the majority of females said they were mostly dissatisfied with their abdomen, thighs, and hips (Sarwer, Thompson, & Cash, 2005).
    Entering college is a key transitional period for young adults. They face challenges adjusting to new surroundings and workloads (Greaney et al., 2009). College students appear to be even more prone to weight gain than those who do not attend college (LaCaille et al., 2011). College enrollment is a documented time for weight gain, averaging 3 to 7 pounds in the first year (Delinsky & Wilson, 2008). Approximately 95% of students report eating sweets and fats, and only 6% eat two or more servings of fruits or vegetables daily (Brunt et al., 2008). Furthermore, a sedentary lifestyle compounds the problem with 50% of college students not meeting their required daily physical activity (Keating et al., 2005). This qualitative study explored American overweight and obese college students' personal stories about their experiences of obesity focusing on their behaviors and perception including physical activity, diet, and their perceived motivators and barriers for healthy behaviors.

Methodology:
Recruitment
Overweight and obese university students (Body Mass Index 25 or higher) from a southwestern regional university in the United States were recruited for in-depth qualitative interviews. Participants were recruited via flyers on campus, on the University department website, and by e-mail. Interested participants contacted the researchers, and the participants were given a brief description of the study and a consent form a week prior to the interview to decide their participation. Following the consent process, an initial screening took place to qualify participants for the study. Each participant's height, weight, and body fat percentage were measured by a researcher. A SECA portable stadiometer was used for the height measurement. A TANITA BF-350 body composition analyzer was used for weight and body fat percentage measurements. The qualified participants filled out a basic demographic survey including sex, age, birth date, ethnicity, geographical location, marital status, number of children and adults living in their household, and current household income.

Data collection
Data were collected using semistructured interviews by researchers trained in qualitative techniques. Interviews were conducted face-to-face in a private room with one or two researchers during the academic year 2013-2014. The researchers used conversational interviews to discuss the participants' experiences for 45-60 minutes. The researchers asked participants about their daily college life routines including physical activity, diet habits, barriers, challenges of being overweight or obese, and motivators to become healthier. Each interviewer asked a series of key questions including the following:
1. Can you describe your daily physical activities?
2. What are the barriers for you to become physically active?
3. What would motivate you to become physically active?
4. Can you tell me what you eat in general from breakfast to dinner including snacks?
5. What are the barriers for you to eating healthier?
6. What would motivate you to eat healthier?

Interviews were audio-recorded and transcribed by trained researchers. Each answer was organized in an Excel spreadsheet by interview question number.

Data analysis
Data analysis used qualitative emergent themes and categorization based on grounded theory (Glaser & Strauss, 1967). The researchers used

open coding to categorize the major ideas from the interview answers using triangulation for validation.

Results:

General Characteristics

Nineteen overweight or obese university students (female=11 and male=8) participated in the study (see Table 1 for general characteristics). The average age of participants was 30 years (range 19-53) and less than half (9; 47.4%) had never been married. Participants had a mean BMI of 31.8, and more than half (12; 63.2%) were obese. Based on the TANITA body composition analyzer data, a majority of participants (16; 84%) had high and very high body fat percentages for their sex and age.

All participants had tried to lose weight in the past. Approximately half (11; 57%) had tried to lose weight by only controlling their diet. Participants reported that they had tried diets such as counting calories, fasting, diet pills and diet programs such as Weight Watchers, NutriSystem the Atkins diet. A little more than a quarter (5; 26%) tried to lose weight by only exercising. Participants reported that they used aerobic activities including using a treadmill, video tape workouts, and steppers. Only two participants (10%) tried to lose weight using both diet and exercise.

Table 1.

Participant characteristics	
Characteristic	
Age	
Range	19-53
Average	30
Sex	
Female	11 (57.9%)
Male	8 (42.1%)
Marital Status	
Single	9 (47.4%)
Married	4 (21.1%)
Divorced	5 (26.3%)
Separated	1 (5.3%)
Geographical location	
Urban	10 (52.6%)
Suburban	2 (10.5%)
Rural	7 (36.8%)
Obesity Classification	
Body Mass Index	
Overweight	7 (36.8%)
Obese	12 (63.2%)
Obese I	6 (31.6%)
Obese II	6 (31.6%)
Body Fat Percentage	
Moderate	3 (15.79%)
High	3 (15.79%)
Very High	13 (68.42%)

Daily physical activity and perceived barriers

The researchers asked "Can you describe your daily physical activities?" Based on their report, seventy-three percent (14 out of 19) did not meet the physical activity guidelines for Americans (150 minutes of moderate intensity aerobic activities; U.S. Department of Health and Human Services, 2008). Participant reasons fell into four categories: a lack of time (31%), feeling tired (26%), lack of internal motivation (26%), and self-consciousness (17%). The most frequently reported barrier was time: *"Time, having yeah, trying to schedule it in with all of the commitments I have" (50 year old female).* Feeling tired was a barrier for participants as well. Participants reported not having the endurance they needed to be physically active: *"I don't have the endurance I once had. I get tired easily" (25 year old male).* Lack of internal motivation was also a challenge for participants, 26.3% of the students reported not having the motivation to be physically active. *"I tried working out a few times but I'm really not a physically active person so I give up because I'm too lazy" (21 year old female).*

Participants also recognized their lack of internal motivation and body image as a barrier: *"Um, one thing is laziness…and I think that's the main thing laziness and not wanting to work out when other people are around the gym." (20 year old female).* The participants showed a common theme of self-consciousness and an uncomfortable feeling either working out or eating in front of other people.

Perceived motivators for physical activity

Participants reported their perceived physical activity motivators as seeing quick results (physical appearance), realization of additional weight gain, and social support. Half of the interviewees (11; 57%) mentioned that seeing results in terms of losing weight, developing a better physical appearance, and/or becoming physically stronger would motivate them. *"I wanna see it immediately, I wanna see, if you say I do this weight loss program and I can lose 10 pounds in a week then that's what I wanna do" (37 year old female).* Another common theme we observed was that the realization that gaining additional weight would cause health threats (e.g., their medical doctor recommended losing weight) was motivating. *"If I gain more weight, ya, well, I mean if I got up to 260 pounds to 280 pounds I would definitely change something" (33 year old male).* Having a workout partner was also motivating to become more physically active. *"A workout partner. Not like a trainer but like a good friend would help. I do a lot better with someone with me" (25 year old male).*

The researchers noticed that there were three participants who could not think about what would motivate them to be physically active. *"Um, that's tough question. What would motivate me?…Um…honestly I have no*

clue. I think I've tried, I've got pictures of what I've wanted to look like and I've tried a lot of variations, I've tried telling myself, looking at myself in the mirror telling myself get up and I always slack off. …um……I don't know maybe laziness; I don't feel like getting up and going to the gym" (20 year old male).

Daily eating and perceived barriers

Seventy-three percent (14 out of 19) reported eating unhealthy foods throughout the day. The unhealthy foods that participants reported were highly processed foods containing high sodium such as fast food, microwavable dinners, canned food, and boxed food. Forty-two percent (8 out of 19) showed a lack of knowledge on how to make healthy food choices. *"Um probably just to know what to pick out when I go to the grocery store… but knowing what is good and what is not anymore is the thing. Umm, they [the school] could offer maybe some kind of nutrition class that would help me decide what's actually good for me and what's not" (44 year old male).*

A participant reported eating in his car by himself because of being self-conscious about binge eating. *"The last time I went I got a 20-piece chicken mcnuggets, 2 mcdoubles and a medium french fry, but that's not usual, that's kind of more of a if I were to workout really hard one day, then I'll eat something like that to make sure I'm eating" (22 year old male).*

Participants were asked if there were any barriers and challenges that they faced when trying to eat healthily. Their perceived barriers for eating healthy foods were lack of time, inconvenience, money, a lack of social support, and temptation or addiction to foods. Thirty-six percent of interviewees (7 out of 19) reported that time and inconvenience was a barrier for healthy eating: **"***Having the time to eat healthier umm being that I have my kids and a thousand other things going on, it is kind of hard for me to sit there and make something healthy instead of just grabbing something and going" (29 year old female).* Twenty-six percent (5 out of 19) stated that money was a factor when trying to eat healthily. Participants perceived that buying *healthy* food is more expensive than buying *unhealthy* food: "*Money to eat healthy, because cost of living is high, the cheap stuff isn't healthy for you" (21 year old female).*

Lack of social support was also a challenge in eating healthier: "*A lot of it, my family is southern so of course a lot of it is fried foods. That's been my hardest part of losing weight is at home. I'll try to buy healthy foods but of course on the weekends we will visit my parents and its always southern cooking" (25 year old male).* Foods like desserts and cheeses were mentioned as temptations: "*Yes, just choice I guess. It's hard to resist temptations like dessert. If I didn't buy it, I wouldn't eat it but I do buy it and*

I do eat it. It's hard for me not to enjoy the little things; I don't see myself as overweight so I can eat dessert" (19 year old male).

Perceived motivator for healthy eating

Participants were asked what would motivate them to eat healthier. Their perceived motivators to eat healthy foods fell into four categories: health concerns, self motivation, & inexpensive healthy food availability. Six out of nineteen participants (32%) reported that having health problems would motivate them to eat better: "*I'm already scared of heart disease and stuff like that the motivations are there for me, like trying to eat healthier. Like I don't want to end up like my mom, I don't want to have chest pain and have to keep natural glycerin in my pocket all the time or anything like that I don't wanna have a stroke like my brother did and he actually my ex-step brother past away last year and he was only a few years older than me and he passed away of a stroke already. But I mean he had other health problems too but things like that scare me into being motivated basically" (29 year old female).*

Self-motivation was a motivator for forty-two percent (8 out of 19) of participants: "*It's gonna have to be me" (47 year old male).* The other common motivator discussed was the availability of inexpensive healthy food: "*m... cheap prices (laughing) would make it a lot easier to be willing to do that or be able to do that. Mainly all boils out to money and time, cause I prefer to eat healthy cause I feel better when I do but it just again time and money" (21 year old male).*

Self-consciousness

Self-consciousness was an emergent theme that arose in the course of the interviews. Eleven out of nineteen (57%) participants responded that they are self-conscious about their body: "*It makes you not take pictures of your whole body. Ever. You only take head shots. It makes you feel inadequate next to a skinny person, so you're kind of less likely to talk to somebody new" (29 year old female).* Half (11; 57%) of the interviewees were having trouble finding clothes that fit: "*It makes it hard to find clothes that actually fit, and then you feel self-conscious in clothes that do fit cause sometimes they're too tight in certain areas" (21 year old female).* These were not exclusive: one interviewee delayed enrolling in a required physical education course at the University until she had to for her graduation requirements: "*I waited three years going here before I even took a PE class cause I was so scared to even get in front of somebody in athletic clothes" (29 year old female).*

These issues also affected participant eating behaviors as well. One participant described eating by himself in his car because he did not want to

show what or how much he eats in front of others: *"I am not eating on campus. I'm self-conscious probably is really why honestly if that makes any sense. I don't like eating in front of people" (22 year old male).*

Conclusion:

The purpose of this qualitative study was to gain perspectives from overweight and obese college students on their past and present experiences including weight loss attempts, physical activity, eating habits, and their perceived barriers and motivators for healthy behaviors. Due to the nature of this study, there are several limitations. Because participation in this study was voluntary, there may be a self-selection bias within the sample. It should be noted that during our interview process, the researchers did not define healthy or unhealthy eating but instead had participants provide their own definition.

From the results, there were shared commonalities between overweight and obese college participant's perception toward physical activity and eating behaviors. Lack of knowledge was the most prevalent barrier for the participants. They were unable to identify healthy and unhealthy behaviors that aligned with national guidelines and recommendations. The overweight or obese participants in this study had unpleasant feelings about themselves, which affected their physical, emotional and social health. Self-consciousness was another key barrier for participants, along with motivation, and negative personal experiences. The results support the previous literature on psychological issues (Sarwer, Thompson, & Cash, 2005), the lack of daily physical activity (Keating et al., 2005), and the lack of healthy diets (Brunt et al., 2008). This suggests that health promotion is needed for overweight or obese college students to foster healthy lifestyles.

In addition, we wanted to suggest possible actions that the university could take to help those students. The study showed that participants were lacking in knowledge and motivation to make healthy lifestyle choices. Students wanted nutrition classes that provided information and guidelines on what to eat and how to cook healthily. While the university offered nutrition classes, student participants either were unaware of them or did not acquire functional knowledge from them. Similar to Greaney et al.'s (2009) research, the participants wanted students, faculty, staff, and administrators to work together to make meaningful changes within the university environment.

We conclude that providing educational opportunities on what to do to be physically active, and how to do it would benefit obese and overweight individuals. They also need to be educated on dieting and weight loss. Participants reported negative past experiences that caused them to become

overweight and being unhappy with their current weight. We also recommend counseling programs to help them overcome their past negative experiences that were related to their physical and mental health. Further research should include study a younger population as well.

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Adolescents' and Parents' Perceptions About Core Values to Individual and Family Life: A Cross-Sectional Study Involving Seven European Countries

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Abstract
        Family, community and school are privileged contexts to acquire and consolidate fundamental values for governing individual life and interpersonal relations across lifespan, and such learning is more effective if there is congruence in the messages learned, and if children and adolescents are stimulated to develop critical thinking competences to deal with information. Involving a convenience sample of 889 subjects, 446 adolescents and 443 parents from seven European countries to whom a self-administered questionnaire was applied, this paper presents the main results

of cross-comparisons between and within countries about the perceived importance of values for family. Participants were also asked to do a self-evaluation of themselves as models of citizenship for others. Overall, mothers tend to consider that values are more promoted in families than fathers, but there are no differences in the opinions of adolescent boys and girls. When males and females are compared with no distinction of generations, the latter agreed more with the significance of values for the family than the former. There are some specific differences between and within countries and sample groups in the evaluation of values and self-perceptions of citizenship performance. Despite the limited number of participants in each country, the discussion of results highlights the importance of debating the values that guide personal and societal principles inside and outside the family, in an effort to construct a world free of prejudice and discrimination and where every person, regardless of cultural, religious or ethnical identities, is invited to contribute to the common well-being.

Keywords: Family values; critical thinking; personal and cultural diversity; citizenship

Introduction

Learning to be a member of society and to participate in community life as a citizen with rights and responsibilities is not an easy task and families usually have the main role in teaching their youngsters about the core values that each person must follow and promote in the course of growing older. Empirical research about family dynamics has already shown that the best predictor of children's ideas is their parents' ideas (Goodnow & Collins, 1990).

The challenges that parents face are also extended to other educational entities, such as schools and teachers, but the power of the messages learnt in the family context tend to have an impact on children's development and actions because of several factors (see Vieira, 2013): family can be considered a protected environment for learning; the strength of ties between family members tends to make role models more significant; learning tends to be more effective when behaviours observed by youngsters correspond to verbal clues from those figures that are emotionally important to them; children are very good observers of those who surround them, and the process of learning through observation begins very early in life, even before they are able to speak about what they see or think.

According to Rokeach (1973), a "*value* is an enduring belief that a specific mode of condute or end-state of existence is personally or socially preferable to an opposite or converse mode of conduct or end-state of

existence" (p. 5). For the same author, "*a value system* is an enduring organization of beliefs concerning preferable modes of conduct or end-states of existence along a continuum of relative importance" (*idem*). In this sense, values are not only related to principles of behaviour but also to general goals of life, and because of that they transcend specific situations (Braithwaite & Law, 1985). Values are therefore organizers that guide people's behaviour and result from personal decisions based on information, experience and available models.

In the process of apprehending, understanding and choosing core values for governing individual attitudes and decisions as well as those related to interpersonal, family and community life, each person learns and uses the information considered emotionally more significant. Thus, the course of becoming a citizen is influenced by inside and outside family models, by opportunities for experimenting with behaviours and discussing and contrasting opinions and by the development of an internal sense of being able to decide what is right or wrong. Such ability requires knowledge, but also coherence between what is deliberately taught and effectively performed. It also requires increasing critical thinking that normally becomes more complex with age, mainly during childhood and adolescence (Sprinthall & Collins, 1994).

It is consensual that families can be seen as dynamic and interactive systems, where parents' modes of action influence sons and daughters and on a reciprocal basis children's and adolescents' conceptions and behaviours influence parents (Jacklin & Reynolds, 1993). Furthermore, we agree that family is "one of the few social groups where members grow together, and where roles relating to power, control, capabilities and authority change over time" (McGillicuddy-De Lisi & Sigel, 1995, p. 353). For this reason, the ideas about the world, goals for life and values advocated by parents and youngsters could be understood as the result of a mutual building process and a negotiation between both parts, sometimes with conflict, these processes culminating in the appearance of shared knowledge (Bugental & Johnston, 2000).

Family life is regulated by such a type of knowledge even though the members aren't aware of it. The effects of shared ideas could be transformed into positive civic and social competences in parents and youngsters, but it could happen that family values constitute an obstacle to the healthy individual development of each member. In fact, the old and new problems of contemporary times may represent challenges to families they may not be prepared to face and answer properly, so the development of a partnership effort between families, schools, and communities is crucial in order to promote the acquisition and consolidation of positive mutual values (European Commission, 2016).The goal of all efforts to promote the

acquisition and use of values is not to teach young girls and boys "what to think, but rather how to think, in order to navigate a world where not everyone holds their views, but we each have a duty to uphold the democratic principles which allow all cultures to co-exist" (Jagland, 2016, p. 7). The process of learning values requires time, knowledge and active practices in different contexts, and youngsters and adults "need the opportunity to examine value dilemma questions both to understand the issues involved and to grow from the experience" (Sprinthall & Collins, 1994, p. 221).

Families, schools and communities have the supreme task of helping the development of "responsible, autonomous and solidary people that know and exercise their rights and duties through dialogue and respect for others, with a democratic, pluralist, critical thinking and creative spirit" (DGE, 2013, p. 1). For such a task of equipping citizens with tools for living together to be effective, it is also crucial to "adopt measures to tackle inequalities and structural disadvantages" (European Council, 2016, p. 18). This is also a common responsibility, at a local, nationwide and transnational level, also involving political decision makers, because problems of exclusion, privation, discrimination and oppression, among others, surely contribute to a distortion of people's values and to societal conflicts like those that we are living through currently.

Methodology

The study presented in this article was conducted during the second year of the Erasmus+ Project "Family, Community and School: the troika of my values" (2014-1-PT01-KA201-001041), financed by the European Union, with data being collected at the same time in the seven countries, ensuring the equivalence as much as possible of all the variables with potential impact on the results. The partners of the project were schools with the secondary level of education from Austria, Belgium, Greece, Portugal, Romania, Slovenia and Turkey. It was a quantitative cross-sectional study, and more specifically a survey that involved samples of students and their parents, and the main goals were to compare, within countries, the degree of agreement between parents and adolescents about some core values to family life and to learning citizenship in a family context, and to do comparisons between countries about the same perceptions both in youngsters and in their parents' generation.

Participants

The convenience sample of the study was composed by 889 subjects, 446 of them (50.2%; 47.5% boys and 52.5% girls) adolescents and 443 (49.8%; 29.1% fathers and 70.9% mothers) parents (see Table 1). The

presence of adolescents of both sexes is balanced in the sample, but more than two thirds of the parents group was composed by mothers. The mean age of the adolescents was 15.77 years old, ranging from 13 to 22 (SD=1.233); for parents, the mean age was 44.70 years old, ranging from 32 to 66 (SD=5.279).

Table 1. *Distribution of the participants by 'family membership', age and sex*

Family membership	n	%	mean (age)	SD (age)	Sex (%)[1]	
					Males	Females
Adolescents	446	50.2	15.77	1.233	47.5	52.5
Parents	443	49.8	44.70	5.279	29.1	70.9
Total	889	100.0	----	----	---	---

(1)These are relative percentages for each group of adolescents and of parents.

In table 2 it is possible to see the distribution of participants by country, which the research team had previously decided to be very equivalent in order to legitimize valid statistical cross comparisons of answers.

Table 2. *Distribution of participants by country*

Country	n (total sample; adolescents; parents;)	%
Austria	130 (70 adolescents; 60 parents)	14.6 (53.8; 46.2)
Belgium	120 (60 adolescents; 60 parents)	13.5 (50.0; 50.0)
Greece	104 (52 adolescents; 52 parents)	11.7 (50.0; 50.0)
Portugal	118 (55 adolescents; 63 parents)	13.3 (46.6; 53.4)
Romania	138 (69 adolescents; 69 parents)	15.5 (50.0; 50.0)
Slovenia	140 (70 adolescents; 70 parents)	15.7 (50.0; 50.0)
Turkey	139 (70 adolescents; 69 parents)	15.6 (50.4; 49.6)
Total	889 (446 adolescents; 443 parents)	100.0 (50.2; 49.8)

Due to between countries comparisons, school level was operationalized through the international classification ISCED (2012; 2014), proposed by UNESCO2. Adolescents participating in this study were

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2 This classification divides the levels of formal education in nine categories, from 0 (early childhood education/no formal education) to 8 (Doctoral education or equivalent). For information, please see: http://www.uis.unesco.org/Education/Documents/isced-2011-operational-manual.pdf (2012) and http://www.uis.unesco.org/Education/Documents/isced-fields-of-education-training-2013.pdf (2014).

students from secondary education (one missing value): 54 (12.1%) were attending ISCED level 2 (Lower secondary education); 391 (87.9%) were attending ISCED level 3 (Upper secondary education). In the case of parents, the variation was higher as expected (11 missing values): 27 (6.2%) from ISCED level 1 (Primary Education); 42 (9.7%) from ISCED level 2 (Lower secondary education); 175 (40.3%) from ISCED level 3 (Upper secondary education); 33 (7.6%) from ISCED level 4 (Post-secondary non-tertiary education); 22 (5.1%) from ISCED level 5 (Short-cycle tertiary education); 99 (22.8%) from ISCED level 6 (Bachelor's or equivalent level); and 34 (7.8%) from ISCED level 7 (Master's or equivalent level). No other socio-demographic variables were considered.

Instrument development

The *Family Community and School 3 Values Questionnaire* (FCS3VQ) is a self-response questionnaire that was developed by the research team to collect data about parents' and students' opinions about the importance of several values to family life and to the development of a sense of belonging to society as a citizen, autonomously and critically participating in it. It is composed by 36 items constructed according to a five-point Likert scale, from (1) *Strongly Disagree* to (5) *Strongly Agree*, and asked participants to express the degree of their agreement with sentences belonging to six defined groups of items. Each of the groups included six different aspects of previously defined conceptual clusters: (1) *General active citizenship*; (2) *Family*; (3) *Health and sexuality*; (4) *Respect for others including intercultural diversity issues*; (5) *Technology and environment*; (6) *Work and School Ethics*.

The first conceptual group (*General active citizenship*) includes items related to universal values like honesty, respect for others, tolerance, self-respect, equal rights, dignity, freedom, solidarity, diversity, justice and democracy; the second (*Family*) involves parental perception of guidance, shared time in the family, generation gap effects, transmission of cultural heritage, and parental role models; the third (*Health and sexuality*) includes items related to the perception of the importance of a healthy lifestyle, the discussion of issues related to sexuality and the promotion of critical autonomy in dealing with information; the fourth (*Interpersonal and intercultural diversity*) contains items related to acknowledging and embracing diversity, different lifestyles and cultural heritage of groups; the fifth (*Technology and environment*) includes items related to promoting sustainable development and raising awareness of technology and its impacts on the planet and society, either at a global or an individual level; and the last category (*Work and school ethics*) aggregates items related to ethical behaviour in the main public spheres of action, such as school and

workplace, financial issues, and social responsibility. The process of questionnaire development was rather complex and challenging because it involved all the team members participating in a five-day workshop in Portugal (March, 2015). The purpose was to decide what kind of values should be included, how they can be conceptually grouped, the phrasing of items initially in English – considering the fact that the questionnaire should than be translated into seven languages for data collection in each country, and the meaning of sentences should be the same for every participant – the type of answer scale, and the logistic and ethical issues involved in data collection.

After a brainstorming activity that consisted of listing all the values considered important for individual and interpersonal relations in the family, school and community, the team of each country agreed upon joining the 33 originally identified values in six conceptual groups or clusters. The next step was to name each group with a general term and then conceptually define the main ideas gathered in each of the six categories of values. The final step was to write sentences related to the defence of specific principles that rule behaviours which are valorized in family context. These were to be presented to the sample participants, asking them to indicate how much they agree with them considering their family ethics. From a set of 53 initial items, all the partners agreed on choosing the best six sentences of each category, with the final version of FCS3VQ having 36 items[3]. It was a criterion for the team not to develop an overlong instrument that could be tedious and time-consuming to fill in, especially for adolescents and parents with lower literacy rates. Due to cultural, religious and political issues (including legal frameworks) specific to each partner country, it was consensual that some matters would be excluded from the questionnaire, the final version of which would be the same for parents and adolescents in all countries, avoiding potential negative reactions, misinterpretations and missing responses. Among such issues some examples can be mentioned, such as alcohol consumption, same sex marriages, more private aspects of sexual intimacy, and the value of intergeneration learning of cultural traditions.

The initial version of the instrument was submitted in each country for translation to the corresponding language and for a pilot study with few volunteer parents and students. Following the advice of authors such as George, Faan, Pinilla, Abbound, Shea and Rand (2013), this pilot study was

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[3]Examples of items include: "Spending time together as a family is essential" (item 1); "Working with someone who has religious principles that are different to mine is a problem in my family" (item 21; reverse-coded item); "In our family it is unacceptable to talk openly about sexuality" (item 32; reverse-coded item); "Good education is the most important thing for a person's future" (item 34).

used to do a cognitive debriefing through interviewing techniques with the participants and to refine the final version of the items, allowing the identification and clarification of problematic words, unclear meanings, confounding terms and doubts about the response scale. This preliminary work was crucial to refining the final version of the instrument that was consensual for all researchers in the team.

Because the overall goal of the instrument was connected to perceptions about values that the family promotes in the process of learning and exercise citizenship, a separate question was included at the end inviting participants to indicate how they evaluate themselves as models of citizenship for others, from (1) Very Unsatisfied to (5) Very Satisfied. The questionnaire took about 15 minutes to answer.

Procedures of data collection

Following ethical codes in each country about conducting scientific research with minors, the team of each school was responsible for contacting the national entities required in such a process. They then contacted the families of students, asking for written consent from parents/tutors – prepared by the research team and equal in all countries – allowing data collection with their adolescent sons and daughters. In the case of parents/tutors and in order to prevent potential error factors4, they were the first to answer the self-report questionnaire after their volunteering consent, mainly in schools during regular parents' meetings, ensuring anonymity and confidentiality of responses. Only after the administration of the instrument to mothers and fathers (or equivalent figures in terms of the responsibilities to school), were adolescents whose parents/tutors had given permission for their participation in data collection asked to answer the same instrument during class time with the support of teachers, with the same ethical guarantees.

Results

This section will be divided into subsections due to the amount of information and the need to make comparisons within and between countries. Beginning with the psychometric properties of the instrument (FCS3VQ), we then analyse results by country and between countries comparing the degree of agreement with values of adolescents and parents through the calculations of analysis of variance (ANOVA). Age and schooling level of parents were not significantly correlated with the results on the questionnaire (r=.008;

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4 Among these potential error factors is the possibility that adolescents may inform parents about the content of the questions; they may help parents to answer the questionnaire if the instrument was taken home; parents and adolescents may agree on the opinions expressed about values.

p=.878) and with self-evaluations of citizenship (r=-.037; p=.451). The very unequal distribution of parents by schooling level categories (ISCED levels) made any possible use of this variable weak for data analyses. Thus, the two variables of age and schooling level of parents were only considered for sample description. For adolescents these two variables were controlled because they were from the same school level in each country and data were collected in the same period of the school year.

Each country's data will appear by alphabetic order of the countries' names. The possible differences in subsamples size across comparisons with numbers presented in Tables 1 and 2 are due to missing values, which were not replaced in order to respect the original data.

Internal consistency indicators of the questionnaire

In Table 3, Cronbach's alfa indicators for each scale are presented as well as for the total scale. For the entire scale internal consistency was equal to .835 when considering all the subjects, and .785 for the subgroup of adolescents and .808 for the subgroup of parents. These are very satisfactory psychometric indicators.

Table 3. *Internal consistency of subscales and of total questionnaire*

FCS3 VQ	Cronbach's Alfa
Subscale 1 (*General active citizenship)* = 6 items	.421
Subscale 2 (*Family*) = 6 items	.683
Subscale 3 (*Health and sexuality*) = 6 items	.524
Subscale 4 (*Interpersonal and intercultural diversity*) = 6 items	.512
Subscale 5 (*Technology and environment*) = 6 items	.501
Subscale 6 (*Work and school ethics*) = 6 items	.396
Total questionnaire (global sample) = 36 items	**.835**
Total questionnaire (sample of adolescents) = 36 items	**.785**
Total questionnaire (sample of parents) = 36 items	**.808**

As it is possible to confirm in Table 3, the conceptual division of items from the questionnaire in six groups wasn't authorized by statistical analyses of internal consistency of the subscales, because the values of Cronbach's alfa were too poor to permit the use of the subscale results separately for interpretation purposes. So, it was only possible to go further on data analyses using the global result of the questionnaire, either for the total sample, or for parents and adolescents considered independently.

Data from Austria

In table 4 it is possible to explore data from the total sample and the subgroups from Austria in the answers to the values questionnaire.

Table 4. *Results in FCS3VQ from Austria*

Within country comparisons	Subgroups	n	Mean	SD	F	p
Comparison between fathers and mothers	*Fathers* *Mothers*	14 43	141.79 147.61	23.972 15.169	1.148	.289
Comparison between boys and girls	*Boys* *Girls*	40 30	132.58 129.37	10.539 12.781	1.323	.254
Comparisons between adolescents and parents	*Adolescents* *Parents*	70 57	131.20 146.18	11.575 17.674	32.940	**.000**
Comparisons between males and females	*Males* *Females*	54 73	134.96 140.11	15.468 16.783	3.118	.080

In the sample of Austria parents tend to agree more than adolescents about the importance of values for the family [F(1, 125)=32.940; p<.001], and there are no other significant differences between subgroups compared.

Data from Belgium

Table 5 presents data from the sample of Belgium.

Table 5. *Results in FCS3VQ from Belgium*

Within country comparisons	Subgroups	n	Mean	SD	F	p
Comparison between fathers and mothers	*Fathers* *Mothers*	17 43	139.65 146.09	15.803 12.889	2.676	.107
Comparison between boys and girls	*Boys* *Girls*	22 38	130.86 133.18	10.139 12.647	.539	.466
Comparisons between adolescents and parents	*Adolescents* *Parents*	60 60	132.33 144.27	11.754 13.949	25.679	**.000**
Comparisons between males and females	*Males* *Females*	39 81	134.69 140.04	13.470 14.255	3.833	.053

As happened with Austria's sample, in the participants of Belgium it was also possible to detect a statistically significant difference about the opinions of adolescents and parents, with parents again the group that tend to agree more with the importance of values to family life [F(1, 118)=25.679; p<.001].There were no other differences between groups.

Data from Greece

Data from Greece are shown in Table 6.

Table 6. *Results in FCS3VQ from Greece*

Within country comparisons	Subgroups	n	Mean	SD	F	p
Comparison between fathers and mothers	*Fathers* *Mothers*	15 37	161.20 157.27	11.07 18.13	.608	.439
Comparison between boys and girls	*Boys* *Girls*	32 20	139.91 139.15	12.496 13.003	.044	.835
Comparisons between adolescents and parents	*Adolescents* *Parents*	52 52	139.62 158.40	12.572 16.399	42.993	**.000**
Comparisons between males and females	*Males* *Females*	47 57	146.70 150.91	15.594 18.570	1.527	.219

Also in Greece, parents [F(1, 102)=42.993; p<.001] tended to score higher than adolescents when evaluating the significance of values for family members. There were no other differences between groups.

Data from Portugal

Data from Portugal are shown in Table 7. The first comparison was not calculated for this sample because of the reduced number of fathers who agreed to answer the questionnaire.

Table 7. *Results in FCS3VQ from Portugal*

Within country comparisons	Subgroups	n	Mean	SD	F	p
Comparison between fathers and mothers	Fathers	7	158.43	9.947	---	---
	Mothers	37	158.62	10.523		
Comparison between boys and girls	Boys	21	142.71	13.473	.777	.383
	Girls	27	146.07	12.809		
Comparisons between adolescents and parents	Adolescents	49	144.71	12.957	32.142	**.000**
	Parents	44	158.59	10.321		
Comparisons between males and females	Males	28	146.64	14.299	4.827	**.031**
	Females	64	153.33	13.039		

Note: In the case of Portugal the number of fathers did not allow valid statistical comparisons.

In the Portuguese sample there are two significant differences that could be interpreted. Again, as in previously analyzed countries, parents tend to agree more than adolescents [F(1, 91)=32.142; p<.001] about the importance of values for their family. When males (fathers and boys) are compared to females (mothers and girls), this second group scored higher than the first [F (1, 90)=4.827; p=.031], which means that females of the sample tend to consent more than males on the significance of values for their family principles.

Data from Romania

It is possible to see the results from Romania in Table 8. In this sample there are three statistically significant differences between groups.

Table 8. *Results in FCS3VQ from Romania*

Within country comparisons	Subgroups	n	Mean	SD	F	p
Comparison between fathers and mothers	Fathers	15	138.47	7.900	.344	.559
	Mothers	69	140.20	10.662		
Comparison between boys and girls	Boys	28	128.50	10.571	5.875	**.018**
	Girls	41	134.39	9.442		
Comparisons between adolescents and parents	Adolescents	69	132.00	10.261	20.390	**.000**
	Parents	69	139.83	10.098		
Comparisons between males and females	Males	43	131.98	10.76	8.637	**.004**
	Females	95	137.69	10.51		

Adolescent Romanian girls tend to agree more than boys on the importance of values for family life [F(1, 67)=5.785; p=.018]; parents scored

higher than adolescents [F(1, 136)=20.390; p<.001] on FCS3VQ; and females of the sample tend to consider values as more significant than males [F(1, 136)=8.637; p=.004] as rules for family conduct.

Data from Slovenia

Data from Slovenia can be examined in Table 9.

Table 9. *Results in FCS3VQ from Slovenia*

Within country comparisons	Subgroups	n	Mean	SD	F	p
Comparison between fathers and mothers	Fathers	25	149.84	13.322	2.306	.134
	Mothers	45	154.13	10.087		
Comparison between boys and girls	Boys	36	127.97	12.192	.826	.367
	Girls	34	130.82	14.033		
Comparisons between adolescents and parents	Adolescents	70	129.36	13.101	124.986	**.000**
	Parents	70	152.60	11.442		
Comparisons between males and females	Males	61	136.93	16.592	6.418	**.012**
	Females	79	144.10	16.602		

In this sample parents also tend to agree more on the importance of values than adolescents [F(1, 138)=124.986; p<.001], and as in Romanian and Portuguese samples, females also tend to score higher than males in their opinions on the questionnaire [F(1, 138)=6.418; p=.012], thus considering values more important for guiding family life.

Data from Turkey

Data from Turkey appear in Table 10 and the comparison between fathers and mothers shows an interesting result not observed in other countries.

Table 10. *Results in FCS3VQ from Turkey*

Within country comparisons	Subgroups	n	Mean	SD	F	p
Comparison between fathers and mothers	Fathers	27	145.00	12.866	11.669	**.001**
	Mothers	29	155.34	9.674		
Comparison between boys and girls	Boys	22	142.41	14.861	1.461	.232
	Girls	30	146.70	10.764		
Comparisons between adolescents and parents	Adolescents	53	144.60	12.747	5.717	**.019**
	Parents	56	150.36	12.374		
Comparisons between males and females	Males	49	143.84	13.710	8.912	**.004**
	Females	59	150.95	11.051		

In the Turkish sample, mothers agreed more than fathers about the importance of values to family life [F(1, 54)=11.669; p=.001]; there are differences between adolescents and parents, as in other samples, with the latter scoring higher than the former [F(1, 107)=5.717; p=.019]; and there are statistically significant differences in the answers of males and females [F(1, 106)=8.912; p=.004], women being more likely to agree about the importance of values for family life than men.

Between country comparisons

The comparisons between seven countries were made contrasting data from the same groups as was done for within country analyses: mothers *vs*. fathers; boys *vs*. girls; adolescents *vs*. parents; males *vs*. females. The results obtained are shown in Table 10.

Table 10. *Results in FCS3VQ by subgroups – all countries considered*

Between countries comparisons	Subgroups	n	Mean	SD	F	p
Comparison between fathers and mothers	*Fathers*	120	146.87	15.838	5.025	**.026**
	Mothers	288	150.45	14.206		
Comparison between boys and girls	*Boys*	201	134.30	13.138	2.819	.094
	Girls	220	136.49	13.602		
Comparisons between adolescents and parents	*Adolescents*	423	135.47	13.401	202.890	**.000**
	Parents	408	149.39	14.775		
Comparisons between males and females	*Males*	321	138.99	15.435	23.900	**.000**
	Females	508	144.40	15.559		

With the exception of adolescents of both sexes, there are significant differences in answers of other groups, when all countries are considered together. Mothers tend to agree more than fathers [$F(1, 406)=5.025$; $p=.026$] about the importance of values for the family; parents scored higher than adolescents [$F(1, 829)=202.890$; $p<.001$]; and females displayed a higher degree of agreement with the sentences about family values promotion than males [$F(1, 827)=23.900$; $p<.001$].

The results of all countries cross comparison in the total score of FCS3VQ are described in Table 11. Because the test of analysis of variance permits only a global comparison, *post hoc* tests (Vogt, 1993) were then performed to detect differences between specific countries.

Table 11. *Differences in FCS3VQ global score between countries*

Countries	n	Mean	SD	F	p
Austria	127	137.92	16.374		
Belgium	120	138.30	14.173		
Greece	104	149.01	17.335	19.452	**.000**
Portugal	93	151.28	13.635		
Romania	138	135.91	10.877		
Slovenia	140	140.98	16.918		
Turkey	109	147.56	12.828		

Note: *Post hoc* comparisons were than calculated.

Using the Scheffe test of multiple comparisons, it was possible to find that Austria had a significantly lower result at $p<.001$ on the questionnaire than Portugal, Greece and Turkey, not differing from the other countries. Also, for Belgian participants the degree of agreement about the importance of values for family measured by FCS3VQ was lower than for subjects from Greece ($p<.001$), Portugal ($p<.001$), and Turkey ($p=.001$), which tend to consider such values more important for family life. In the

case of Greece, apart from its aforementioned differences in scores with Austria and Belgium (Greek participants scored higher than Austrians and Belgians), the results also show that Greeks agreed more than participants from Romania (p<.001) and Slovenia (p=.008) about the significance of values to family life. The Portuguese sample scored higher, at p<.001, on its agreement with values than participants from Austria, Belgium, Romania, and Slovenia. Romanian participants scored significantly lower than those from Greece, Portugal and Turkey. Slovenian participants scored lower than subjects from Greece (p=.008) and Portugal (p<.001). Finally, respondents from Turkey demonstrated a higher degree of agreement with values for the family than participants of Austria (p<.001), Belgium (p=.001), and Romania (p<.001).

Table 12. *Results in self-evaluations of citizenship comparing adolescents and parents in each country*

Countries	Subgroups	n	Mean	SD	F	p
Austria	Adolescents	70	3.43	.827	3.356	.069
	Parents	59	3.71	.929		
Belgium	Adolescents	60	3.53	.929	9.200	**.003**
	Parents	60	3.98	.676		
Greece	Adolescents	52	3.85	.697	1.316	.254
	Parents	52	3.65	.988		
Portugal	Adolescents	51	4.18	.590	.149	.700
	Parents	48	4.13	.733		
Romania	Adolescents	69	3.71	.621	5.804	**.017**
	Parents	69	3.96	.580		
Slovenia	Adolescents	70	3.46	.912	26.952	**.000**
	Parents	69	2.68	.849		
Turkey	Adolescents	63	3.98	.852	1.147	.286
	Parents	64	4.14	.794		

The responses to the separate question that invited participants to do a self-evaluation as 'models of citizenship' (model citizens) to others are systematized in Table 12, which compares adolescents' and parents' opinions in each country. There are no differences between the two generations in Austria, Greece, Portugal, and Turkey. In Belgium [F(1, 118=9.200; p=.003] and Romania [F(1, 136)=5.804; p=.017], parents tend to evaluate themselves better than adolescents in the exercise of citizenship duties and responsibilities. In Slovenia [F(1, 137)=26.952; p<.001] the opposite was observed, with youngsters being those who scored higher than parents in this variable.

The results of a global comparison between countries are described in Table 13. Again, post hoc tests were further executed to detect between which countries' differences are statistically interpretable.

Table 13. *Differences in self-evaluations of citizenship between countries*

Countries	n	Mean	SD	F	p
Austria	129	3.56	.883		
Belgium	120	3.76	.840		
Greece	104	3.75	.856	24.294	**.000**
Portugal	99	4.15	.660		
Romania	138	3.83	.611		
Slovenia	139	3.07	.960		
Turkey	127	4.06	.824		

Note: *Post hoc* comparisons were than calculated.

In self-evaluation of citizenship performance, participants from Austria scored lower than those from Portugal (p<.001) and Turkey (p<.001), and significantly higher than subjects from Slovenia (p=.001); Belgian respondents only differ from those of Slovenia, scoring higher than them (p<.001) in their self-perceptions; Greek participants scored higher than Slovenian ones (p<.001); for Portugal the scores were higher at p<.001 than those from Austria and Slovenia; the results from the Romanian sample were higher than only those from Slovenia; this country seems to be the one which had the lowest results in self-evaluations, differing significantly from all the other countries (p=.001 for the comparison with Austria; p<.001 for the comparison with Belgium, Greece, Portugal, Romania, and Turkey); Turkey displayed significantly higher results on self-evaluations than Austria (p<.001) and Slovenia (p<.001). These differences between countries are surprising and the influences on responses could be multiple, considering the fact an abstract and general concept of citizenship is involved, and that this item was one of the most difficult to write due to the inexistence of a term in each language that allows an equivalent translation of citizenship.

Discussion

In all countries that entered in the study, parents tended to evaluate the transmission and cohesion of values in the family context more favourably than adolescents, because they agreed more than the youngsters about the importance of values for family life. Because of weak psychometric internal consistency indicators of each subscale it is not possible to deepen these data analyses, trying to search for greater differences between two generations in specific sets of values. Probably it will be possible with an exploratory factorial analysis of answers, which will be a challenging task in the near future for the research team. Also, with the exception of Austria, Belgium, and Greece, where there is no differences between the two sexes, in other countries such as Portugal, Romania, Slovenia and Turkey, mothers and adolescent girls (as a group) tend to

evaluate values as more important for family principles than fathers and adolescent boys (considered together as a group).

Some unique results of countries, such as the difference in opinions between Romanian girls and boys about the importance of values for the family (female adolescents scored higher than their male counter partners), or the higher agreement of mothers from Turkey when compared to fathers also about the defence of values as principles for the family, could be explained by cultural and religious factors, including traditional gender roles (Vieira, Nogueira & Tavares, 2013; Derks & Ellemeres, 2016), daily routines and responsibilities of family members, composition of family and economic conditions, among other aspects. This could be also true to explain why in countries like Austria, Belgium and Greece, there were no differences between males and females in their agreement about the importance of values, which didn't happen in the samples from Portugal, Romania, Slovenia, and Turkey. In these four latter countries, females tend to agree more than males about the importance of values.

This project intended to make a 'healthy', educative and heuristic comparison of answers of parents and adolescents of the same age, from seven countries, in a questionnaire that asked participants to express their degree of agreement about how important values are for family life. The goal of the study was not to do a ranking of countries or to generalize data and such unwelcome pretensions weren't possible due to the reduced number of participants in each country, the nature of the study and the several error factors unavoidably involved. In fact, results should be interpreted with limitations because of methodological weaknesses that are common in such large-scale comparisons using non-experimental strategies. The translation of the questionnaire from English to the seven languages was a potential threat to internal validity of answers because of specific concepts (like citizenship) and phrasing (Social Security, as a State entity). Other factors that may cause some interference in results are related to participants' family socioeconomic status, the location of schools in each country (more rural or more urban zones), the (lack of) familiarization of parents with this type of surveys or the importance they give to collaborating with school demands, just to name a few.

Overall, these results call attention to the differences in parents' and adolescents' perceptions about the relative importance of values for family life. Parents in all seven countries are more convinced than adolescents that such core values are important and promoted in their families, which may reveal a possible incongruence between parents' beliefs and practices in the family context, less time available than is desirable for communication between parents and children, or a lack of reflection from adolescents about

such values for their life, probably due to age and all the transformations and requirements of adolescence as a developmental stage.

According to Sprinthall and Collins (1994), "the maxim that growth depends upon interaction holds for value development just as surely as it holds for all other forms of development" (p. 214). This calls for the importance of having time in a family context – and also at school and other educational contexts – to create situations to discuss values, to help children and adolescents to progressively acquire the ability to understand the diversity of human beings not as a problem but as a richness for mutual relationships. Also such opportunities may be seen as valuable moments to foster awareness both in the youth and in educators (e.g., parents, teachers) about the complexities, challenges, and advantages for all of *living together as equals in culturally diverse democratic societies*5.

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5 This is the second title of a publication of European Council (2016), *Competences for democratic societies. Living together as equals in diverse democratic societies*. Retrieved from: http://www.coe.int/t/dg4/education/Source/competences/CDC_en.pdf

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The Effect of Teacher's Proxemic Aspects on Didactic Relationship in Swimming

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Abstract

    This article is interesting in didactic distances (Forest, 2001) of two Physical Education (PE) teachers of Swimming in Tunisia. Its objective is to determine the different proxemic distances (Hall, 1966) of teachers at the time of didactic regulation. We postulate that proxemic distances represent a revealing of didactic relationship. The methodology of this research is qualitative and clinic. It could be registered within the frame of clinic didactic interactions of PE and on the clinic analysis of experimented and novice teacher's practice glimpsing "case by case" and to apprehend the singular subject in didactics (Terrisse, 1999). Data collection and analysis are organized according to the clinic didactic methodology. This temporal methodology differs by three different times and crusaders. From methodological point of view, this study limits itself to the second time analysis, that of the test (Terrisse, 2000). We make the choice to focus on the qualitative study of proxemic distances scale (Hall, 1966). Results put in evidence that the practice of different proxemic modes by teachers have effect on the didactic relationship.

Keywords: Ostension, proxemy, clinic didactics, didactic relationship, Physical Education teachers

Introduction:

Many researches in PE, studied the didactic interactions of regulations (Gal Petifaux, 2000; Mahut 2003; Kammoun, 2004). However, few of them tackled proxemics (Forest, 2006; Legrand (2006); Vinson, 2013) to study the didactic distance. This original article is interested to determine the different proxemic distances of teachers at the time of didactic regulations. Are these proxemic distances proved to be revealing in the didactic relationship in Swimming?

Historically speaking, the sociologist Edward Hall (1966) defined proxemics as the *« set of all comments and theories concerning the use that man made of space as cultural product ».* He showed equally that environment perception is in connection with the spoken language. In fact, *« Individuals belonging to different cultures, not only speak different languages, but which is more important, they dwell different sensorial worlds »* (Hall, 1966, 1971). According to this author, environment perception and the distance are two intimate related parameters.

To analyze the different observed types, we are going to rely on Forest's four configurations (2001) that are inspired from Hall distances models (1978). It is about distances: intimate, personal, social and public. Being adapted to the study of didactic interactions, these distances are constraints by proper environment of the class and its topology and by the necessity of social and didactic control, that the teacher must achieve their use.

We present these proxemic distance configurations as follow (Forest, 2001): The first configuration (public): It is superior to 1 m. It concerns the placing of instructions and group control. It corresponds to the « comfort zone » where there is the basis which we are going to describe. We borrowed the last notion from psychology to name this space where a person feels total security, we add that « comfort zone» is a conductual state where a person operates within a neutral anxiety relationship, using a limited range of conduct to produce a *« steady »* level of performance which is in general without a feeling of risk (White, 2009). It is this configuration which comes back constantly in all institutions.

The second configuration (social): It is between 30 cm and 1,20 m. It occurs when the teacher animates a small group of pupils.

The third configuration (remote personal): It corresponds to an « arms length » distance. It occurs when controlling a pupil.
Fourth configuration (close personal): Is inferior to 30 cm. It does not appear and consists of a helping relationship.

The public configuration it is the most representative, followed by the social configuration. This shows that actors of the educative space consider the class as a public and social space more than personal. This translates equally an interest that is clear noted on teaching pole more than in apprenticeship and it comforts the idea of verticality and the approach centered on the teacher. The primordial relationship which maintains teachers with their pupils seems corresponds to group control rather than to knowledge and interactions transmission. All that at the level of questioning and explaining a lecture course to all the group.

In this context, Forest in this thesis *« Proxemic analysis of didactic interactions »* (2006), offers to describe the proxemic behaviors, starting from light considered necessary and sufficient dimensions for teaching. In accordance with his approach, we are not thinking that the term of distance must be uniquely taken from its mathematical meaning but rather in the meaning of the perceived distance or a tool distance.

In the center of didactic interactions, these distances can play a role compared to the commitment within the didactic relationship and the maintaining of it.

Forest (2006) proposes in his work that proxemy manifests in synergy with corps technics. It is about material and linguistic technics allowing the teacher to assume the didactic relationship. This comes in accordance with Berdot, Blanchard-Laville and Camara Dos Santos (1997) propositions that define ostension (at least in its forms) as « revealing about distance of the teacher to knowledge and as identified by the study of different direction gestures of the teacher and the study of the teacher during the management of the different contract ruptures ». Meanwhile, it is the real way for the teacher to have distance and to manage more or less his own knowledge in connection with those proposed by pupils.

Since then, the synergy of proxemic modes and ostensive forms of teachers are influential in the didactic relationship in connection to knowledge of the teacher.

Problematic and research questions

Within the framework of PE, the activity "swimming" is performed obviously in difficult conditions where the intake or the admission of information is confused and the distance between the teacher and pupil is difficult to manage. However, the teacher in a swimming pool changes his place perpetually, in a voluntary way or no, to observe and regulates. Thereby Forest (2006) speaks about didactic distance which defined in function of corps orientation and or glances. This constraint proves particularly important for the dynamic of teacher-pupil interaction in PE in general and in swimming in particular. Through, the focus of clinic didactics

in this study is to analyze "test" time (Terrisse, 2000) which is the interaction moment teacher-pupil. From here we can identify teacher intervention in synergy with proxemy.

Thereby, and to better understand, the recourse to gestural and symbolic combined ostensions and the necessity to vary these displacements, to observe then to regulate, arise also as a synergy, a necessity and a particular appropriated tool to interact. Knowing that we support the idea that proxemy and gestures rythm the didactic time in the meaning of advancing knowledge in a session or a meeting. In fact, the richness of this study which is on proxemy concept and on proxemic modes variation is to reveal that these distances could influence; From one hand in observations and regulations of the teacher and the other hand on his communication and his interaction in swimming-pool. By that these distances can play an important role compared to the commitment in the didactic relationship and the maintaining of it.

From this perspective, our problematic is interesting particularly to study proxemy phenomenon in swimming and its effect on didactic interaction. Attempting to explain this phenomenon, we advance the hypothesis that proxemic different modes used by the teacher, at the time of regulation could improve apprenticeship evolution and the didactic relationship. We would like to clarify that the study of the conceptual focal « proxemy » in swimming has not been completed at least in a Tunisian University environment. Ranging in this problematic, we questioned if the didactic distance between the teacher and student in swimming could affect the didactic interaction.

Since then, this article is interesting to know the movement "arm crawl" attempting to bring in answers to the following questions:

a) Is proxemic aspect of teachers influential in didactic relationship in an aquatic environment?

b) What are the convergences and the divergences between proxemic practices of two teachers associated to the research?

Based on Hall (1966) works on proxemy, we will try to decrypt the interactional and communicative activity of the teacher with students. Though the inclusion of interpersonal distance scale, our objective is to study qualitatively and quantitatively teacher's mode of distance in his intervention and to free or to clear a type profile and or a proxemic distance modeling revealing of the dynamic and the evolution of didactic relationship in class space.

Method and tools

This research inserts in the field of PE clinic didactics. It is qualitative and exploratory. Hence, we have recourse to the clinic didactic methodology which is organized on three temporal professorial action the

"already-there", the "test" and the "post stroke", (Terrisse, 2000). But our methodology is limited to the second time the "test" (Terrisse, 2000) which is defined to real time to support teachers during the session. In order to analyze this time, we have associated in our qualitative approach a quantitative data treatment to measure teachers proxemic aspects.

We headed of from a finding where proxemy between the teacher and the student is unstable and difficult to manage and from a hypothesis where proxemic modes could influence the didactic relationship. To treat the latter, we first registered in the field of PE clinic didactics. There after, we performed two studies in the case close to two teachers and their students at Higher Institute of Sport and Physical Education (ISSEP) of Tunis.

Study population

The experimentation was performed in the region of Tunis in February 2015, at Bardo swimming pool. Two first year classes of fundamental licence in PE at the (ISSEP) Ksar Saïd have been retained for the experimentation of our protocol. Apprenticeship sessions about the crawl stroke were programmed to each of the two classes, that the level is swimmer. Two specialized teachers in swimming with the different professional experience insure sessions. In fact, the first one is an experimented expert teacher. He disposes more than ten years of experience in swimming teaching. While the second one is a beginner expert, she is specialized in swimming and she starts her second year in the matter.

Observation protocol

We have observed a session in the middle of a cycle related to Crawl stroke apprenticeship for each teacher. This observation helps guarantee a didactic density, indeed and according to Marsenach & Mérand (1987). The first consecrated sessions to diverse evaluations are just rich in teaching contents. The first observation took place with the experimented expert teacher that we call (EA), however the second observation is with the expert beginner, whom we call (EB). Each session lasts from 40 to 45 mints.

Data collection

Data collection and data analysis are registered in a temporal methodology which is organized in three times. The "already-there", the "test" and the "post stroke", (Terrisse, 2000). In the framework of this study we restrict ourselves to analysis of the second time of professorial action relative to test time. Here exactly is the actual moment when the subject is summoned to the complex reality of the class (Terrisse, 1999). In fact, we have selected test time because it corresponds to the interaction moment

between teacher and student and that during this interaction we can really see teacher intervention in synergy with proxemy. Moreover, the test corresponds to the moment of interaction between teacher and student. Thereby session observations stand as a test to the teacher and sometimes to the research, in the sporting sense of the term since he never knows how the lesson of PE is going to happen (Terrisse, 1994). The used data collection methodology rests on a method and two technics (De Ketele, Roegiers, 1993). The used method is observation in situ associated to image and sound recordings. The first technic is used to capture teacher gestuality which is performed by the help of a video tool that stands on two camera-videos: One is fixed focalizing on the subject teacher and a mobile one which allows to with draw pertinent extracts and « contextualities » starting from a wide shoot of the class. The second technique is used to register integrally the verbal of the teacher which is consists of audio-micro tool.

During the test, video and audio recording sessions are finished by an organized *ante-session* and a *post-session* interview. Data collection and analysis rest on « interpersonal distance scale » tool which is defined and formalized by Hall (1966), see **table 1**.

Distance	Close mode	Remote mode	Distance
Intimate - **ID**	Corpse to corpse - **C**	From 15 cm to 40 cm	
Personal conversation - **PCD**	From 45 to 74 cm - **C**	From 75 to 125 cm - **R**	Universal interpersonal
Social interaction - **SID**	From 1,25 m to 2,10 m - **C**	From 2,10 to 3,60 m - **R**	
Public - **PD**	From 3,60 m à 7,50 m - **C**	From 7,50 m beyond - **R**	

Tableau 1: Interpersonal distance scale (Hall, 1966).

Data treatment

SportsCode Elite 10.3 Software was used on a MacBook Pro 15in with 2,66 Ghz Intel Core i5 CPU, 8GB RAM and 7200 rpm hard drive with Mac OS X Mountain Lion 10.11 in order to cut out recordings and to index each extract in order to obtain a graphic that reports all cuttings in function of their duration.

In the window of SportsCode Codification (**Figure 1**), our choice of code buttons and labels allow us to concentrate on session indicators which we will use in our analysis. Our codification window could be simple or complex, according to our functioning mode and can evolve during the session.
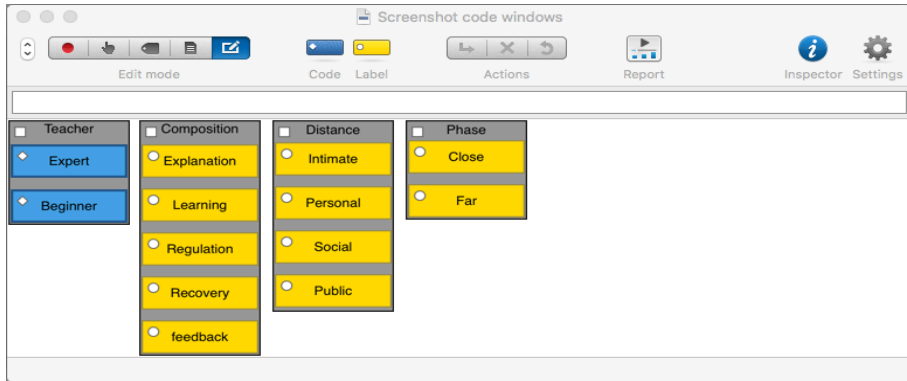
Figure 1. Screenshot code windows SportsCode Elite 10.3.

Once the video is associated to Timeline (**Figure 2**), codification could also be done manually and we can visualize fragments that we have already coded.
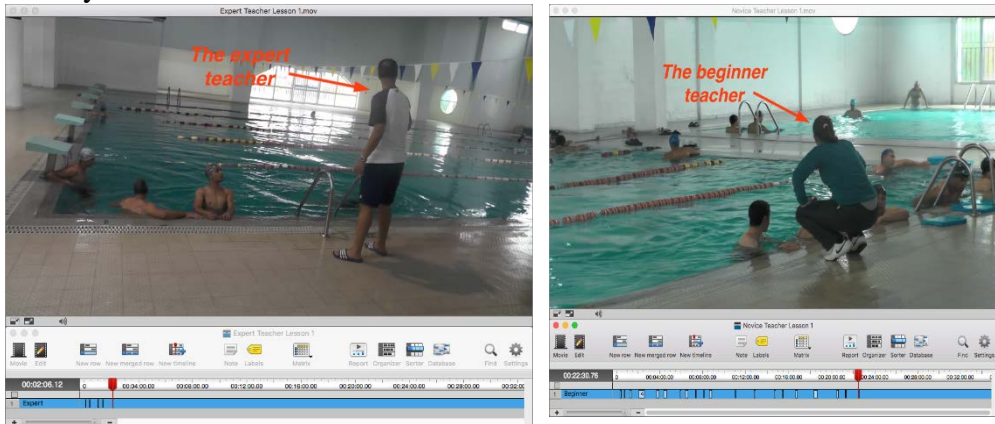

Figure 2. Timeline de SportsCode Elite 10.3.

Results

The obtained results from each study of case are illustrated in **graphic 1** which corresponds to the second time of professorial action, as mentioned above, related effectively to the test (Terrisse, 2000). During the test, the different proxemic aspects (Hall, 1966) of teachers are identified starting from video and audio recordings of sessions and SportsCode Pro Software measures them. The time of the test is about 40mn of observation amongst the two teachers.

Graphique 1: Proxemic aspects of two cases.
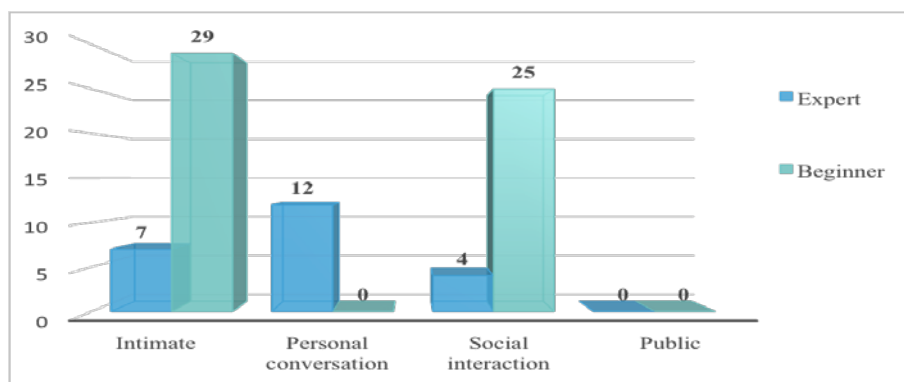
Discussion

At the beginning of tests and during explanation phase, the EA teacher obviously uses a remote personal distance of conversation (RPDC) (75cm/1,25m) with 6 renewals. He deploys the same distance during regulation phase with 3 renewals and he keeps the same number of renewals at recovery phase. He uses remote intimate distances (RID) three times during explanation phase (15cm/40cm), 4 times during learning phase and only one time during the Feedback. This distance allows to transmit and to communicate knowledges orally and allows equally to show arm movement to all of the group. As well as Forest (2006) notes in his work that proxemy manifests in synergy with corps technics.

He uses also, a close social distance of interaction (CSDI) (1,25m/2,10m) with two renewals at learning phase and remote social distance of interaction (RSDI) (2,1m/3,6m) with two renewals during target phase. This distance allows to observe students in order to regulate them.

From the beginning of the session to its end, the EA oscillates progressively between close social distance of interaction (CSDI) (1,25m/2,10m) with 4 renewals, a remote intimate distance (RID) (15cm/40cm) with 8 renewals and a remote personal distance of conversation (RPDC) (75cm/1,25m) with 12 renewals.

These 24 distances vary near some students, whom seem to be animated by desire to transmit and to communicate the appropriate knowledge in an ostensive manner in order to understand, to feel and to regulate. They are motivated and successful in arm movement. Knowing proxemy and gestures rythm the didactic time in the meaning of advancing knowledge in a session

For the case of teacher EB, she uses only two proxemic modes during the session: The remote intimate distance (RID) (15cm/40cm) with 29 renewals and close social distance of interaction (CSDI) (1,25m/2,10m)

with 25 renewals. She uses also the remote intimate distance (RID) positively (15cm/40cm) 13 times during regulation phase, 8 times during recovery phase. All this is to address all student of the group. We noted also, that she prefers to resort to close social distance of interaction (CSDI) (1,25m/2,10m) with 25 renewals: 6 renewals during learning phase, 16 during regulation phase and 3 times during recovery phase and her objective is to address a small group of students or only one student.

To conclude, we notice that the moments when EB stands on 2,10m the maximum are for 29 items. Whereas we obtain 25 items to a relatively close intimate distance comprised between 15cm and 74cm. We notice that the space where EB moves and where she hardly comes out, is a space where she seems standing more on the case, more sure about herself. We borrowed « *confort zone* » notion from psychology to name this space where a person feels security. About that we will add that the « *confort zone* »: is a conductual state when a person operates wthin an *anxiety-neutral relationship, using a limited conduct range to produce a « steady* » level of performance in general without a sense of *risk* (White, 2009).

The obtained results put in evidence that the expert experimented teacher moves obviously and changes involuntary his positions around the swimming pool in order to be able to observe then to regulates like what Catteau notes (1997), displacement of the teacher on the edge of the pool reveals an expertise and seems otherwise linked to the subjacent intention to his observation. These aspects proved to be important within the frame of interaction teaching-apprenticeship because teacher observation consists more obviously of a trigger (Catteau, op. Cit).

EA uses also combined ostensions (Sghaier & al., 2016) and varied proxemic aspects during the test of teaching. It is notably about personal distance of conversation that is considered as a universal distance. However EB does not use the distance. In fact she tends to move very little though out session.

This shows that personal distance of conversation it is the most representative in swimming activity, followed by social interaction configuration. And those teachers consider the swimming pool as a personal and social space than public.

Conclusion

Though the proxemic aspects scale used by (Hall, 1966), test graphic 1 analysis allows us to illustrate divergences between proxemic modes used by two associated teachers. In fact and during the test, the expert experimented teacher uses more varied proxemic modes: Intimate remote distance, remote social distance of interaction and remote personal distance of interaction. However, the expert beginner teacher uses

particularly the close intimate distance mode as well as the social distance of interaction.

We also note that EA is obviously distant and in a setback from his students, which allows him to observe and to regulate students apprenticeship and remains confident in an aquatic environment. By contrast EB is rather close to his students, first to enunciate and to explain the knowledge verbally. Then to keep them under control. It is not worthy that apprenticeship process do not move with the EB, since Gal-Petitfaux (2003) notes that break and dialogue times have to be controlled. Indeed, although necessary, these times stand halt time with apprenticeship process and they are constraints in front the evolution of the didactic relationship in swimming (Sghaier & al., 2016 ; Ben Jomaa & al., 2016). Since then, teachers proxemic practices are related to the different didactic interactions.

Consequently, dialogue times and the lak of movement at the level of the expert beginner teacher in class space is influential imperatively on his teaching method, on students apprenticeship as well as on didactic interactions in class. However, varying didactic distance, observe to regulate and privilige the personal universal distance seem to be features that caracterize the expert experimented teacher method which also evolves the didactic relationship. Professional experience is obviously linked to professional career and to the extended profession practice. She acquires over the years of practice and through the experience which is connected notably to context diversities wherein the teacher has intervened. This corresponds to learning by practice (KJ Arrow, 1962). Since then the influence of professional competences on the decisional process of teachers is « a dynamic factor of knowledge transformation that to be taught to a knowledge effectively taught » (Carnus, 2001) and transmitted in situ.

The objective of this study is to show that the didactic distance (Forest, 2006) could be practiced in a voluntary way or not. First is to conduct the didactic environment, second to evolve and to optimize the relationship. Finally, the perspective of this article consists of that this proxemy could be combined with several ostension forms, which help PE teacher (beginner, expert and experimented) to select the intervention mode within an effective teaching framework of Topo-kinetic activities.

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Sustainability Education Through Active-Learning in Large Lecture Settings: Evaluation of Four Out-Of-Class Exercises

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Abstract

Large classes on sustainable development present certain challenges. Often high student to instructor ratios encourage passive learning pedagogies. However, because sustainability education seeks to increase awareness and help students shift to more sustainable behaviors, more active learning is often prescribed by pedagogical experts. This study provides analysis of four out-of-classroom activities undertaken by students in recent offerings of an experimental course on sustainable development taught at Sonoma State University in California, USA. Those activities, innovated specifically for this course, attempt to increase learner centered activities in large classes that averaged 124 students. Analysis of open-ended reflections indicates that many students experienced raised awareness of sustainability issues. Beyond aspirational statements, student reflections and actual behavioral tracking indicate some shifts to lower carbon food choices in just four weeks.

Introduction

In this time of shrinking classroom resources, academicians are often encouraged to develop and employ innovative leaner-centered pedagogies which typically require more effort from faculty. The following research and analysis arises from attempts to increase active learning instituted in a large introductory course on sustainable development. That course was created in the summer of 2015 and mounted twice in the ensuing school year. One of my goals in designing the course was to create meaningful out-of-classroom activities that could be managed given the unavailability of instructional resources beyond my own efforts. My other goals beyond helping students understand and problemaitze more and less sustainable modes of

development were to: 1) raise awareness of the students' personal relationships to climate change and unsustainable practices, and 2) foster changes in behavior, towards more sustainable personal and systemic practices.

This paper examines the efficacy of the four learner-centered activities I designed for the course. These include two CO_2e (carbon dioxide equivalent) tracking worksheets, one focused on food and the second on transportation. These activities yielded specific quantitative data which reflect behaviors and any changes therein. A third activity took advantage of free public bus ridership for our students sponsored by Sonoma County Transit. The final activities exploit several campus as a living laboratory (CLL) efforts. For all four activities students submitted a 350 word reflection on their experience. I intentionally gave minimal instructions for the reflections to allow the students to identify the aspects of the experiences that were most meaningful to them.

Before describing the activities in greater detail the paper first revisits some of the relevant literature on sustainable education. In the subsequent section I briefly review coding methods and then provide a somewhat quantitative analysis of the spreadsheets and also the reflections. Analysis of the reflections provide insights into subjective experience not captured by the quantitative analysis, thus I draw from and share comments indicative of some common themes and experiences. I conclude with some suggestions to increase the efficacy first of the activities themselves and then of the empirical data as indicators of behavioral change.

Sustainability Education: Consumers, Citizens, and/or Critical thinkers

Sustainability education professionals offer a wide range of recommendations for course design. A primary concern is to help students understand their role in wider human-environment relations, and to motivate them to first take responsibility and to act in ways that they feel are more appropriate (Rachelson, 2014; Saylany and Blumstein, 2011; Chalkley et al., 2010). Isenhour (2015) argues that once instilled, changes in consumption ethics tend to continue and expand. Many argue that introducing students to life cycle analysis helps develop environmentally moral selves (e.g. Barnett, 2005). Along those lines, critical examination of Fair Trade products help people see their consumption as part of wider moral economies (Luerchford, 2008). Understanding the ways their consumption connects students with distant people and places cultivates affective perspectives (Feathrstone, 2011) which Moser (2007) argues is essential to shifts toward more sustainable consumptive behaviors.

Several authors offer critiques of framing people as consumers as the necessary focus of any paradigm shift. Leonard (2010) argues that while

important, changing individual consumption behaviors is insufficient to achieve the wider goal of sustainability. Isenhour (2015) argues against what she calls "weak sustainable consumption", which aims to educate consumers about the problems caused by extraction, production, consumption, and disposal, and then counts on educated individuals working thorough markets to produce development that is sustainable. She states that there is considerable irony in expecting to solve problems arising from free markets and high consumption with even less regulation and additional consumption. Green consumption may in fact lead to increased commodity choice. Instead, she argues that state regulation is needed for "strong sustainable consumption". Alternately, Leonard (2010) argues that political activation of citizens may provide a way to create successful regulation of consumption.

The notion that we must provide our students with a deeper sort of understanding is supported by several sustainability educators. Wals and Blewitt (2010) argue that courses on sustainable development need to cultivate what they call *gestaltswitching* – the ability to alternate between explanatory world views and focus upon a variety of spaces in a global context. Robbins et al.'s *Environment and Society: A Critical Introduction* (2013) is a clear introduction to that project. The book very clearly introduces students to seven widely circulated discourses employed to diagnose human-environment dysfunction and their respective prescriptions for solutions to a range of cases. My students gained the ability to see environmental sustainability issues from each of these perspectives. Moseley et al.'s *An Introduction to Human-Environment Geography: Local Dynamics and Global Processes* (2013) provides a similar approach, but is not written so as to be accessible to most students in lower division general education courses in the California State University (CSU) system. Along similar lines, Sterling (2009) argues that courses on sustainable development should cultivate what he calls "ecological intelligence". Towards that end curriculum should aim to instill a critically holistic, inclusive, and systemic perspective; but one that also appreciates what already works well and encourages creative thinking about new alternative human-environment relations.

But what does this look like in a classroom? Working from Van den Bor (2000), Cotton and Winter (2010) offer several pedagogical techniques. Several of these are difficult to conduct and manage in a very large introductory class without teaching assistants, the usual case on CSU campuses. These include: role-plays and simulations, debates, problem based learning, and field work. The authors also recommend several learner centered activities which are possible in large and thinly supported classes: learning by doing rather than being told, designing group experiences, learning of one's role in human-environmental relations through experience,

rather than focusing on memorizing course content. The authors suggest that activities work towards learner-centered curriculum which is said to more effectively links one's self to theory than does transmissive, lecture-centered learning. Learning by direct experience may also work to increase both awareness of students' roles in dysfunctional human-environment relations, as well as understandings of personal responsibility and agency to make changes.

The challenge then is to design and conduct a large, thinly supported, introductory general education course on sustainable development that both cultivates gestaltswitching (Wals and Blewitt, 2010) and meaningfully incorporates student-centered active learning. My focus here is on the latter. In the following sections I first describe the out-of-classroom activities I designed and incorporated into the class. I then present the outcomes of those activities, and discuss their efficacy and potential improvements.

The Activities

Over the two semesters course enrollment averaged 124 and classes were populated primarily by freshmen and sophomores. Students were asked to participate in four separate out-of-class activities. Two of these were initially inspired by a paper presented at the 2015 Conference of the Association of American Geographers by Alisa Hass. Those activities asked students to download an Excel spread sheet I designed which allowed them to daily track the carbon equivalent emissions produced separately by their transportation and by their food consumption.

Multiple sources for carbon dioxide equivalent (CO_2e) emissions for both transportation and food are available, primarily among non-peer reviewed sources. My goal was not to create a tracking worksheet that would characterize all variability, but to provide the student with a reasonable estimation of their CO_2e emissions. For the transportation tracker I had the students enter how many miles the travelled by automobile that day. I chose a mile per gallon coefficient of 20 and entered the CO_2e in the spreadsheet calculation. Students had choices of driving singly, or riding with 2-4 other people in the car with accordingly lower CO_2e emissions. The spreadsheet was designed to show grams of emission in the cell adjacent to their entry, In an effort to increase interest in and reward none motorized forms of transportation I designed the tracker to give carbon credits for minutes spent bicycle riding, skateboarding, or walking, specifically *instead of* driving, i.e. for trips that they would otherwise drive.

For food selection CO_2e emissions I chose sources that encompassed CO_2e emitted throughout the life cycle through extraction, production, storage, and distribution and consumption. The initial tracker offered students 106 different food and beverage choices. After feedback from the

first class I added selections bringing the total to 121, increasing snack options and adding shrimp. Following the second class exercise, several students requested additional juices, and soy and almond milk and cheese specifically.

For both activities, students completed a one week training worksheet and submitted that through our University's on-line learning management system. I had students first complete and submit a one week training worksheet, and was able to very quickly identify problems with individual submissions and coach specific students in correcting errors. The students then sequentially tracked modes and quantities of transportation and food choices over two four week periods. At the end of the four weeks students submitted their worksheets and an unstructured 350 word reflection on their experience. I left these open ended as I wanted to see what the students felt was most important. Students who successfully completed the exercises received two points for their training week, seven points for the four week tracker, and three points for the reflection (of 100 possible points for the class). Thus the food and the transportation tracker each constituted twelve percent of their course grade. During the semester, my evaluation of submissions was cursory, verifying proper entry of data and meeting the word count target for reflections. Analysis was limited to calculating weekly class averages of carbon emissions. The worksheets are designed to make those calculations quickly in order to introduce aggregate results into class discussions.

Students engaged in two additional out-of-class activities. The first exploited a new program sponsored by Sonoma County Transit which allows students to ride busses without charge. The assignment was simply to make one bus trip. I provided only a link to the transit agency's website and a caution to plan their return trips. Students had five weeks to take their ride and then submitted an open-ended 350 word reflection on their experience (six percent of their grade). The first semester I had students include a selfie photograph to verify participation. That seemed unnecessary and so I eliminated that requirement the second semester. Again, because the Sonoma State University provides no teaching assistance beyond a few hours of undergraduate reader time, these reflections were not carefully evaluated during the semester. The value lies in the experience and the contemplation of that rather than in meeting pre-determined criteria.

Students also engaged in a campus as a living lab (CLL) experience. This activity articulates with a wider effort by CSU faculty and staff to create educational experiences through the use of our campus and its surrounding community and landscape. Students had the option to participate in one of three experiences:

1) Sustainable buildings: a student led tour of our Recreation Center which was built to Silver LEED standards and features a wide range of sustainable practices (45 minutes).
2) Sustainable kitchens: a behind the scenes tour of our food service operations led by one of our professional managers focused upon increasing sustainable practices (45 minutes).
3) Environmental Technology Center agroecology gardens: hands on garden work led by a student expert (2 hours).

Through our learning management system students selected which of these three activities they would participate in. Students also enrolled in specific CLL activities which were scheduled at alternate times with enough advance notice so that all were able to successfully schedule attendance. Again, students submitted a 350 word open-ended reflection on their experience (six percent of course grade).

Results and Analysis

In an effort to draw meaning from the reflections I developed codes for each activity. This was a dialectical rather than a determinist process. To identify important themes I first read 15-20 reflections from each activity, and drew significant codes from what the students themselves wrote (Charmaz, 2014). I then performed an initial word search of specific key terms, highlighting appropriate instances using coded colors. I then read each reflection more thoroughly identifying any themes not identified in the first iteration of review.

a) Bus ride

For the bus activity I detected and coded for three self-identified sub-populations: first time riders, experienced riders, and all others. Here the two groups are aggregated as course conditions were similar as were results among the two groups. Portions are illustrated in Figure 1. I identified six common codes which are given along the horizontal axis of Figure 2. Each of the themes, or codes, required specific treatments of the texts. The self-identification into sub-populations required a reading of each reflection, as did the codes for bus system dysfunction, and "will not ride again". The identification of "pleasant experience" was facilitated by word searches for the terms: good, relax, nice, friendly, enjoy. Unpleasant experiences were initially identified by key word searching for: *confus*, *anxi*, *stress*, *creep*, *scar*, *nervous*, *safe*, and *afraid*. It is important to note that this is not a survey. Students were not asked whether they would ride again, yet of all students forty eight percent volunteered that they would ride again, and fifty four percent of students who self-identified as first time ever riders volunteered that they would ride again. Additionally, sixty two percent of

identified first time riders and fifty three percent of all riders reported that at least aspects of the bus trip were positive. Perhaps most significantly, of all students forty eight percent specifically stated, without prompt, that they would ride again; and first time riders most frequently reported positive experiences and an intent to ride again.
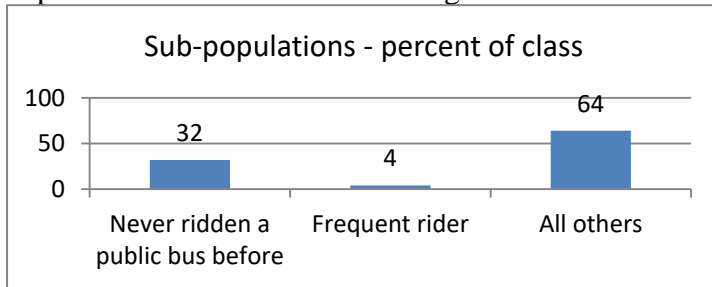

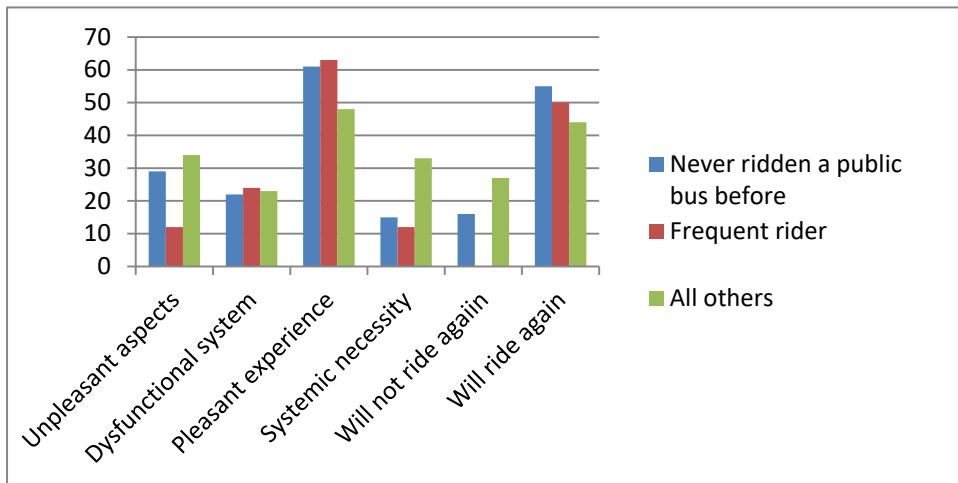**Figure 1.** Percentage of students commenting on experience with public bus ridership.

Figure 2. Frequency of common themes among the three sub-populations of ridership as percentage of total sub-population.

Alternatively, many students reported problems with the transit system. Of all students, thirty eight percent reported unpleasant experiences. Most of these involved either anxiety or fear about catching or missing a bus, and so were not about the system, but rather about their own inexperience. Some reported uninvited conversations with socially marginal community members, while others complained of odd smells. The second most common negative experience involved the inconvenience of the system due to late or infrequent bus service. Indeed, twenty two percent of all students commented upon the dysfunctionality of Sonoma County Transit. On the other hand, twenty six percent volunteered the idea that mass transit is a necessary part of a sustainable socio-environment.

b) Campus as a living lab

The Recreation Center   Approximately forty percent of all students chose either the Kitchens or the Recreation Center tours while the remaining twenty one percent chose the more active Gardens experience. Again allowing the reflections to inform the codes sought therein, for participants in the Recreation Center tour nearly ninety percent of all students commented specifically about the efforts to maximize energy and materials efficiency and re-use (see Figure 3). Comments about the use of natural lighting and carpeting that can be removed, recycled, and reinstalled were most common. That nearly one-quarter of the students used the specific phrase "never thought about" indicates success in raising awareness of energy and materials use efficiency. More notable is the number of students who made comments regarding intent to change behaviors. The difference in that category between the two classes is due in large part to the Recreation Center beginning an arrangement with TerraCycle which recycles batteries, bicycle tires, and foil lined energy bar wrappers, apparently a very commonly consumed food.
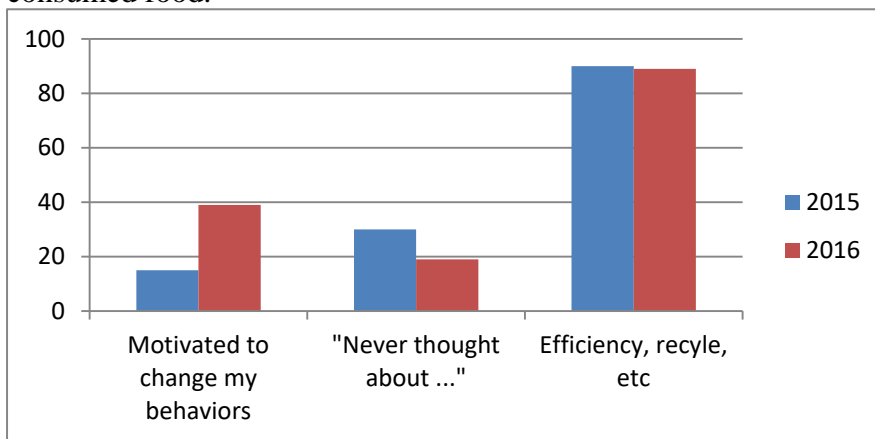

Figure 3. Indicators of awareness among Recreation Center tour participants (percent of total)

The Kitchens Responses to the food service tour also reflect differing emphasis in the presentations. Here the two cohorts' references to awareness of waste (seventy and fifty four percent) and discussion of composting (sixty three and seventy nine percent) is inverted. Over one-third of students commented upon the pride they internalized concordant with efforts at sustainability in the Kitchens. The other very common code focused upon a new awareness of the localness of the food at the kitchens. Among the eighty responses, "local" was used 106 times. Yet only twelve of the eighty students explicitly wrote that they should or would make an effort to buy more local foods themselves
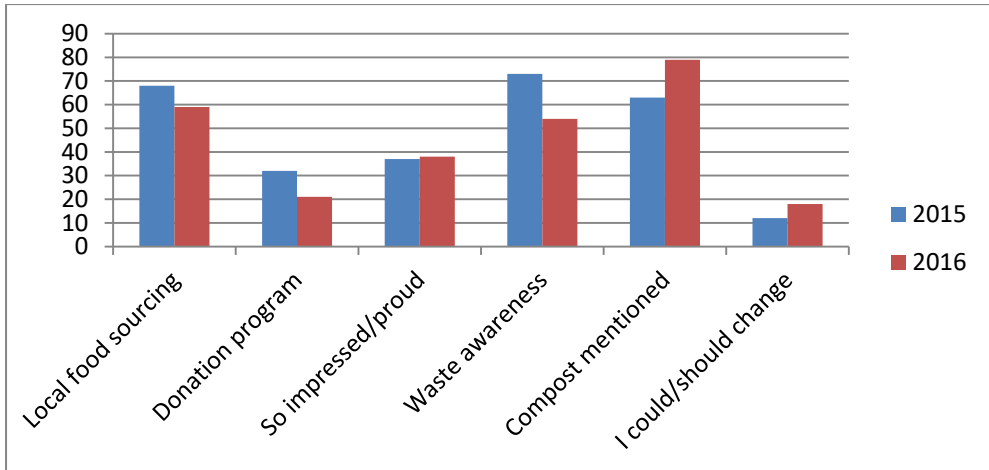
Figure 4. Most common themes among Kitchens tour participants (percent of total)

The Garden Of the three CLL activities, students who chose the garden experience reported much higher expectation of changed behavior. Indeed, forty six percent wrote that they intended to volunteer again. Self-selection probably played a part in that indicator of future behavior. I made clear that the Gardens would be a 2 hour commitment and that they would be actively working rather than more passively following a tour. Thus, students more interested in "doing" were more likely to select the Gardens experience. Consistent with that code, sixty two percent characterized the activity as a positive experience. None made negative comments beyond their expectations. Interestingly, thirty percent volunteered that they particularly enjoyed getting to work with and know new people and the community that formed around shared activities and common goals. Only two of the forty one participants indicated that they had worked at the gardens before.
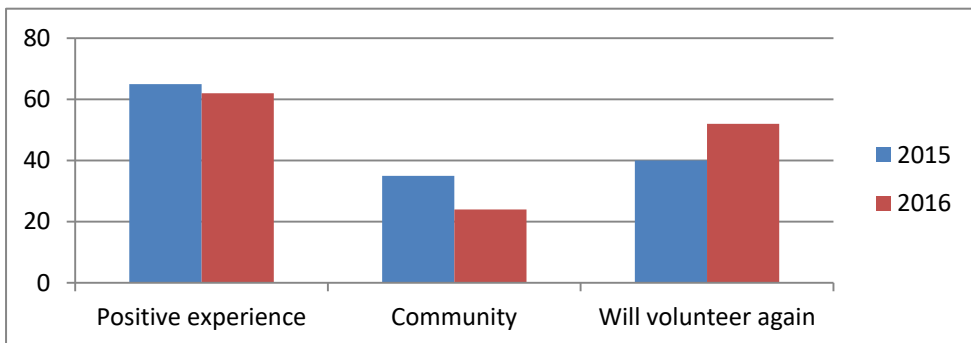

Figure 5. The three most common themes reported in reflections on working in the campus vegetable gardens (as percent of total participants).

c) Transportation CO₂e Tracker

In the alternate semesters students engaged in the two tracking activities in different orders. In 2015, they completed the food tracker first. In 2016, I shifted that activity earlier in the semester in order to coincide with the bus ride activity. I timed all tracking activities so that they would not coincide with any holiday or break longer than three days.

As with the bus ride activity, coding revealed three mutually exclusive populations among the 201 respondents. In the most commonly reported theme, sixty seven total respondents (thirty three percent) suggested that they have, or more frequently will work to decrease their transportation CO_2 emissions. Interestingly, among the group that simultaneously engaged in the bus ride and the transportation CO_2e tracker, forty two percent pledged behavioral change. Among the 2015 class which performed the transportation CO_2 tracker several weeks after the bus ride, only twenty six percent pledged a behavioral change. This suggests some synergy of affect in performing the two transportation related activities simultaneously. Consistent with that result, thirty two percent of the first group reported that they have not or would not change their behavior so as to decrease CO_2 emissions. The exercise did produce one of the intended effects, thirty eight percent of all respondents indicated that their awareness of their CO_2 emissions had been raised.
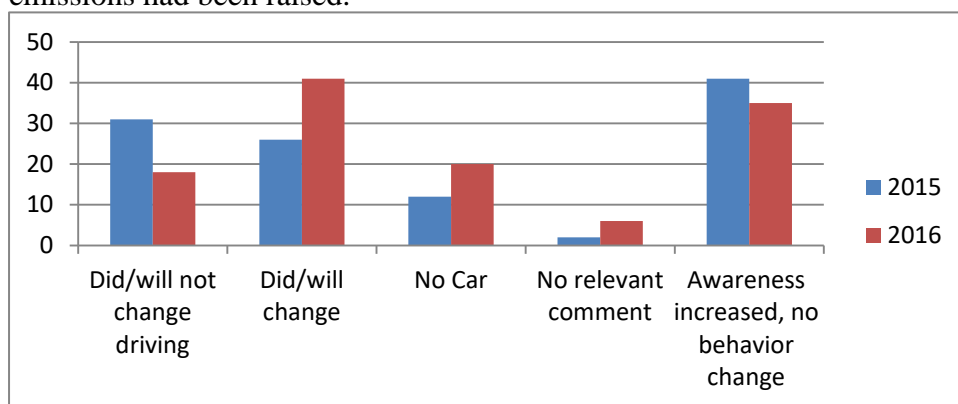

Figure 6. Percent of students reporting common themes regarding sustainable transportation

Among those who reported that they have not and do not intend to change their CO_2 emissions several themes emerged (see Figure 7). Several reported that they are unable to decrease their transportation CO_2 emissions because they must commute to school or work, and there are no viable public transportation alternatives. Others tried to either use public transportation or to form car pools, but did not succeed. Over one-fifth volunteered that a systemic change is needed in order to create a public transportation network that effectively moves people as they need in a timely fashion. Only sixteen

percent of those that did /will affect a change also identified a need for systemic change. This suggests that those who aspire to change, but have not yet attempted to do so, may be less aware of the difficulty of making such a change than those who have tried. Finally, thirty six percent of these respondents volunteered that their awareness of the issue had been raised.
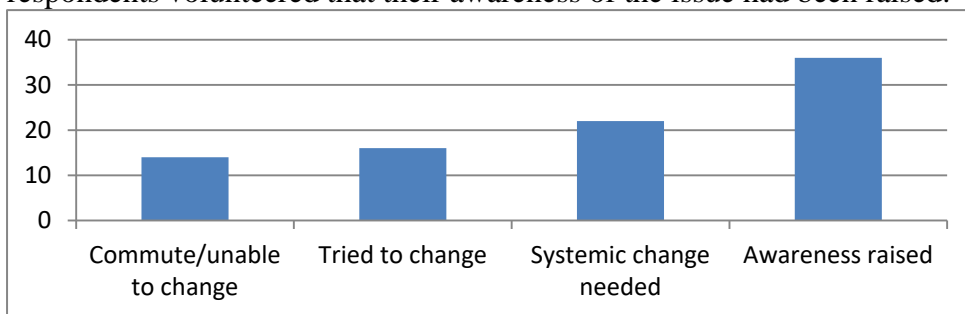

Figure 7. Most common themes among students who reported raised awareness but no behavioral change (percent of total).

In addition to submitting a reflection on their Transportation CO_2 tracking experience, students also submitted the tracker itself, thus allowing for some analysis of actual behavioral change between the first and forth weeks. As Figure 8 indicates, average emissions were least in the first week, then increased approximately eighteen percent over the next two weeks, then declined, though not to Week One levels. In class discussions of his result students indicated that they travelled, primarily home, more on the subsequent weeks. Among a population that travels less than 100 miles per week on average, several students making weekend trips of several hundred miles could clearly increase average travel and emissions for the entire group.
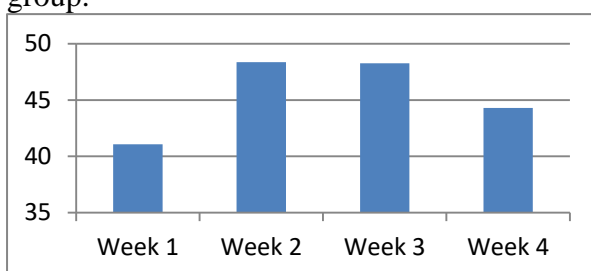
Figures 8. Average kilograms of transportation related CO_2 emitted by each student over the four week study period.

67

The trends illustrated in Figure 9 may also reflect non-routine travel to family homes. They certainly do not indicate general changes in behavior to decrease transportation CO_2. Over the study period car sharing decreased significantly, from fifty nine to fifty percent of miles travelled (this figure incorporates the correction discussed below). This stands in contrast to the forty three percent of students who explicitly volunteered in their reflections that as a result of this activity they will increase their use of carpools and use alternative transportation.
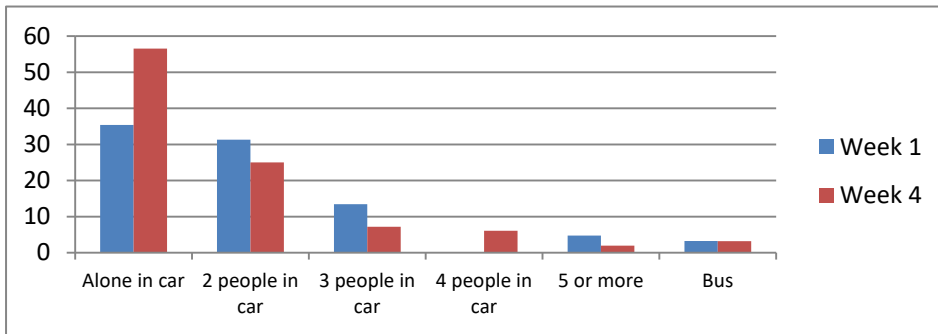

Figure 9. Combined two class use of motorized transportation modes (miles travelled) near beginning and end of study period.
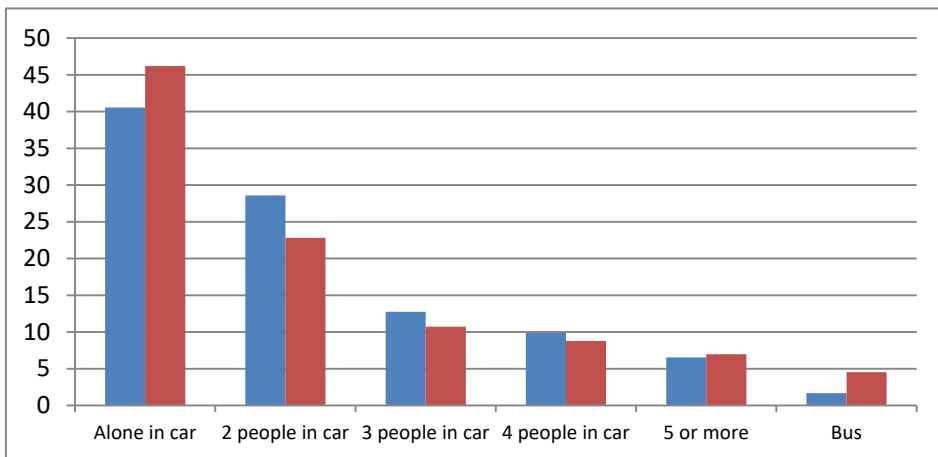

Figure 10 a and b. Illustration of the effect of a single bus trip home by one student in 2016.

Some critical review of outliers in student reports is in order. For example, Figure 10a indicates a significant shift in miles travelled by bus among the 2016 cohort. However, one student reported a single 1,530 mile bus trip. Figure 10b removes that trip and the trends look very different. With that correction the number of weekly student miles traveled alone in a car increased from forty one to forty six percent. Thus, even with a relatively large population of 98 students, here a single student was able to alter the frequency distribution for the entire cohort.

d) Food CO$_2$e Tracker   As with the bus ride activity, coding revealed distinct populations among the 205 respondents in the food related emissions exercise. One group claimed behavioral change while another stated clearly that they have not or will not change food choices in an effort to decrease food related CO$_2$e emissions, while a third reported in increase in awareness but did not reflect upon their associated behavior. The clearest signal in the data is that far more students claim behavioral change (forty eight percent over both classes) than indicated no change (twenty one percent). The other notable difference lies between the two cohorts. It is important to note that readings specifically about environmentally degrading food production practices coincided with the end of the 2016 food CO$_2$e tracker, but followed the 2015 study period by several weeks. Thus, curriculum related awareness may be partially responsible for the inter-cohort difference. Clearly the 2016 cohort has greater self-reported increase in awareness and claims of behavioral change. Accordingly, the 2015 cohort has a much higher incidence of self-reported intention to not change than the 2016 class (thirty two and six percent). Eight students focused so singularly on calories and personal health as to not comment on their diets' CO$_2$e.
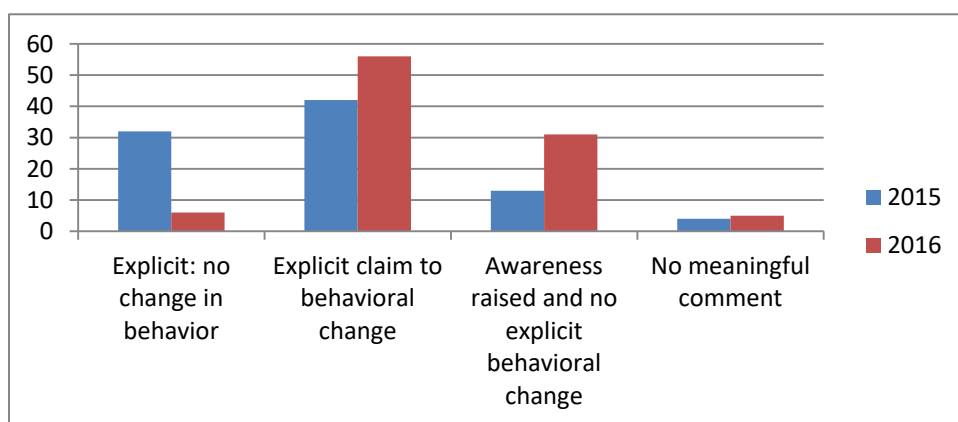

Figure 11. Percent of food CO$_2$e self-identifying response to the exercise.

Analysis of the students' spreadsheets provides some evidence of behavioral change among low and high CO_2e choices. Consumption of spinach salad with tofu, one of the lowest carbon entrées at 550 grams of CO_2e per serving, increased from twelve servings in Week One to forty seven in Week Four. The three most popular entrees also reflected some carbon awareness. High carbon dishes were consumed less: pepperoni pizza slices with 640 gms CO_2e decreased from 208 to 164 servings, and cheese burgers at 2830 gms CO_2e decreased from 133 to 116 servings. At the same time, chicken with the lowest CO_2e per serving for a 4 ounce serving of meat (760 gm CO_2e) increased from 198 to 247 servings.

Qualitative Analysis of Change in Awareness and Behavior

The reflections submitted by each student for each of the four activities provide more qualitative evidence of their changing awareness and potential for behavioral changes. In the following discussion I seek to draw out dominant themes and specific comments indicative of change in awareness and behavior, and reasons for the lack of change. In all four cases students were instructed to "write a 350 word reflection on their experience". The prompt is intentionally open ended to allow the students to identify and describe what they found interesting and important, and yielded the type of responses I intended. Each of the four activities produced approximately 100 reflection constituting about 35,000 words of text in each of the two semesters, for a total of about 800 reflections and over 250,000 words. In addition to reading the reflections and highlighting themes, I again used key word searches to initially identify relevant comments.

a) Bus ridership   The polarity in the quality of experience reported by students here is striking. While many reported an often surprisingly satisfying experience, many others commented upon systemic dysfunction:

> *there was barely anyone on the bus. This seemed like it could've been a little damaging to the environment because the bus was putting out a ton of carbon dioxide for only a really small amount of people. …. I like being able to cut back on the amount that I drive just by myself, but it makes me wonder if using the bus in a smaller town is really worth it.*

Comments specifically about timeliness and inconvenience were more common. Many students related having to wait for busses for over an hour and many of these recommended more frequent service and better adherence to schedules. Many of those students also referred to the convenience of using their own cars:

> *[This experience] also reminded me of why I love my car so much, but also to the reality of the matter: when I rode the bus I was not impacting the environment as greatly as I am today. It shows the*

> *common problem with people and the environment today, which is that we knowingly destroy it because it is the easier or cheaper thing to do.*

Another wrote that:

> *Overall, my experience on the bus was kind of eye-opening, but I definitely prefer to drive my car. It feels slightly strange to be surrounded by a crowd of people that you do not know, and to have no control over the vehicle.*

Many students echoed this dilemma, the awareness of riding the bus as better for our common good balanced again the discomfort and personal costs of being among strangers and of not having control.

As the quantitative analysis indicates, anxiety over lack of control and of sharing public space was a common theme. Many of those students also reported satisfaction with challenging and overcoming that discomfort; one student wrote "*... this experience made me realize that public transportation is not as scary as it seems, and that I can incorporate more public transportation into my lifestyle.*" Perhaps even more significantly, a small number of students reported wider life lessons. Some of these came through encounters with permanent residents near campus: "*Was it ideal? Not really. Yet, I did enjoy it. I even helped an older lady with her front yard work on my way. All in all, I truly enjoyed my bus ride experience.*" Others wrote about encounters with residents on the bus ride itself:

> *I did find the bus ride to be very informative. The reason being because I got to see many different people who lived many different lives on the bus ... a lady got on and sat across the way ... [W]e started talking to her about how she rides the bus everyday ... because she wants to become more environmentally sound .... it made me realize how much emissions and smog going into the atmosphere could be depleted by taking more and more cars off the road.*

Several students related uncomfortable encounters with probably homeless residents; however, a few reported positive encounters and significant learning:

> *There was an older lady on the bus who started asking me about food at around 7am, it gave me the creeps at first but she meant no harm and was extremely friendly after getting to know her a little. I didn't want to know if this was her only form of transportation, she had many bags with her full of things. I had the feeling that she was probably homeless but she was extremely happy and content it felt like…. This experience was eye opening, ... It felt good as weird as it may sound to be on the same bus as the older homeless lady, I don't*

> *know how to phrase it I felt equal to her in some sense. It felt good to know that she was happy and not angry at the world.*

This and similar experiences are lessons that are very difficult to replicate in a classroom of any size.

One of the most common themes among those who came away with a favorable view of the bus system was a change of opinion. Many students expressed surprise at the quality of the experience. One wrote "*In the end, we realized bus rides are not as scary as we thought they were*", and another: " *I always thought that buses smelled bad, had sketchy people on it and took forever to get to where you wanted to go. Yet I was completely wrong.*" And finally, a comment that would encourage most college professors:

> *After this experience I'm amazed that I haven't utilized this resource the whole time I've been at Sonoma State or even back home. It concerns me that our society almost demonizes the transit system as I did before rather than glorifying this free and clean way of transportation. Thank you Dr. Baldwin for this eye opening assignment.*

b) Campus as a living laboratory   Again, students had a choice of three activities: Recreation Center, Kitchens, or Garden. Among the students who visited the Recreation Center one of the most frequently reported lessons learned regarded the invisibility of the sustainable technologies employed in green building design. Typical of this lesson, one student wrote:

> *This out of class activity took me by surprise a little bit because I came out of it with information I wasn't expecting. … [the building] had the capabilities of utilizing new technologies to be more sustainable. Most of these technologies can go unnoticed.*

And,

> *I absolutely loved this experience, as it really opened my eyes as to how environmentally sound the building actually is. After seeing this, it really makes me wonder why other places aren't doing this.*

A majority of the students reported upon the various efforts at re-using and recycling featured in the tour: "*all the furniture is made of recycled material. For example, the tables are made from 80% recycled glass or recycled money that is out of circulation.*" Several students also wrote about generalizing these technologies to other buildings, to making more systemic changes: "*I am now curious to see how realistic it would be to have this form of heating in the home",* and "*I loved this lab because I know what I am doing to sustain the environment when I go to the gym and I find it amazing and inspiring how green friendly Sonoma State University is, and I love it.*" Several of these comments also indicate the value in using a building that many students associate with positive experiences, in this case

with recreation, for such a tour. A building associated with classrooms might not have produced the same degree of affinity and pride.

Among students who participated in the Sustainable Kitchens activity, the two most common themes involved decreasing food waste and local sourcing. Regarding waste, many students commented upon specific efforts to reduce, repurpose, or recycle waste, most commonly the change from trays to plates:

> *One of the smartest changes they underwent in the switch was the idea behind changing the trays to plates. The idea was that people tend to eat more with their eyes, so having the trays students would fill the trays as much as they could. Now that there are plates students have less room to put food and they tend to not keep getting up to get more.*

Many students were also intrigued with efforts by the kitchens to buy locally produced foods:

> [The kitchens] *pride themselves on purchasing only local produce from surrounding farms in Sebastopol, Petaluma, Napa, San Francisco etc. I was surprised to hear that the furthest that we import any of our produce is "maybe" Mexico or Arizona for things like watermelon that tend to go out of season in California.*

Interestingly, while students were apparently impressed with efforts to source locally, and many students indicated their efforts to buy locally themselves in their food CO_2e tracking exercise, none extended local purchasing to personal behavior in the Kitchens activity.

As with the Recreation Center activity, several students did report that they have subsequently engaged in educating others about what they learned at the kitchens. One student related sharing lessons learned with their family: "*My parents loved to heard these neat facts about our schools composting and improvements made over the last few years here at Sonoma.*" Again, Walsh et al. (2016) report that this sharing with family was central to and very common amid their study involving High School students.

Among the relatively small cohorts (forty one total) who elected to participate in the Gardens activity, many students commented upon the satisfaction they felt in their own agency:

> *I felt really good about the work we had all done to help the Environmental Technology Center Garden. I learned from this activity that if we make the work fun then we can finish before time and if we all work together and cooperate we can get a lot done in a small amount of time.*

Several reported that they already had or intended to begin their own gardens: *"This activity was mostly insightful because I learned that it's something I really enjoy. Since then, I've been working with a friend on starting a garden."* While many students characterized their experience as enjoyable, many went beyond that to comment upon its meaningfulness: *"I love being in the garden surrounded by colors, dew drops, and life, feeling blissful as I transcend into the environment, so to the garden I return to revel in it some more ^__^"* and another wrote *"What I liked about the garden is that Jake said they produce enough food every year and they give it to homeless and the hungry to feed those in need of food."* Perhaps predictably, the students who chose the more active learning exercise see themselves as being more active in pursuing lessons learned through their CLL activity. As Figure 12 illustrates, of the CLL activities, the garden experience elicited a greater commitment to behavioral change.
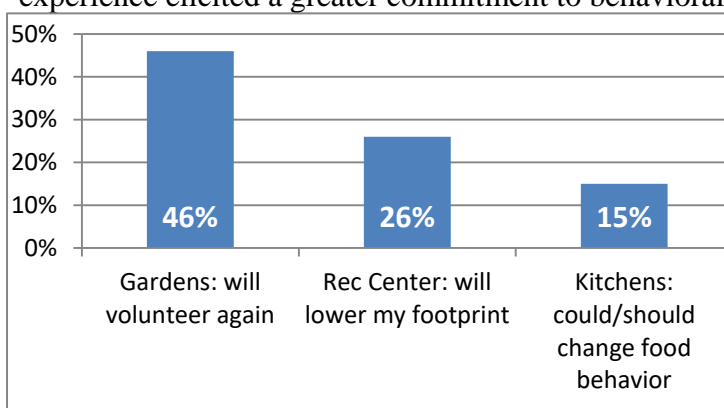

Figure 12. Percent of cohorts pledging resultant changes in behavior.

CO_2e tracking and behavior: transportation   Given the goals of this study are to raise awareness of personal relations with sustainable practices and to foster changes in behavior, the hope is that comments such as the following would be common:

> *a huge difference can be made in our net emissions by even walking for a couple minutes. I made it a point to walk. … Something that helped me reduce the amount of carbon from driving was from attempting to carpool for errands and events as much as possible. My friends and I would plan on going to the grocery store together and visit the mall.*

However, many of the student reports of changes in behavior regarding transportation related CO_2 emission were primarily aspirational (e.g. I will, I plan to). While hopeful, these responses are also troubling. A national study by Lieserowitz et al. (2013) gives some indication of the relationship between aspiration and action regarding efforts to stem climate

change. The authors found that survey respondents often do not act on their aspirations. My analysis of that study finds that of the respondents who stated that they would write to their representatives in the next year, 29 percent did not.

Accordingly, many students reported an increase in awareness, but did not report a change in behavior. One wrote that "*Overall, this experience was eye opening and I realized that I need to stop driving as much as I am and try and carpool and walk more places than I do now*." Along similar lines another wrote that "*Tracking your everyday life via this worksheet helps people realize, as their CO_2 numbers go up, that it probably isn't the best for our planet*." Yet, in many such comments, no indication of behavioral change is evident.

Others reported realizing the excess of reliance upon personal cars: "*For example, this past weekend my friends and I drove 3 separate cars to get food … My friends were being princesses and did not want to ride in the back seat.*" Others reported driving around campus, a maximum of 1.3 kilometers, or to a nearby convenience store which is 700 meters from the furthest dorm. Others attempted to change behavior but were unable to maintain that change for even three weeks:

> *I soon realized during the second week that I was making these short unnecessary trips to the grocery store, every single day to pick up small items. … During the third week I tried picking up all of the crap food that I would eat during the week in one single trip... The forth week I did not consider trying to reduce or thank about my mileage and just drove when and where I pleased.*

Many students did report an increase in awareness. Typical of this theme, one student reported that "*This assignment was a real eye-opener. From now on I will definitely make an effort to emit less CO_2 by biking or walking instead of driving some places*." Yet forty three comments along this theme make no mention of subsequent behavioral change**.**

Of 205 respondents, thirty indicated that they will or could ride their bikes more. However, eighty five respondents volunteered that they cannot ride because they are unable to, do not have access to a bike, or their travel distances are too far. Several wrote that they do not know how to ride. Another seven percent (fourteen individuals) indicated that they do ride bikes, but only 6 volunteered that they had added riding to their transportation modes during the exercise.

Interestingly, one area of reported behavioral change focused upon behavior with friends. There, many students reported successfully increasing carpooling and some of these wrote of changing their friends' awareness. One student reported that:

> *It was fun encouraging my friends to count their miles and examine their CO_2 admissions. I believe this assignment had an impact on my friends … We learned if you want to get groceries and get a new shirt, go to Target and kill two birds with one stone.*

Though fourteen students did report sharing their new awareness of transportation related greenhouse gas emissions with friends and family, this study differs from the Walsh et al. (2016) which found nearly ubiquitous sharing with friends and family. While sharing awareness of transportation related greenhouse gas emissions was not commonly reported, only eight students reported sharing their new Food CO_2e awareness with family and friends.

CO_2e tracking and behavior: food

Climate change education is bedeviled by the invisibility of the effects of both one's own carbon emissions and the aggregate emissions of humanity. One of the goals of the food CO_2e tracking exercise was to produce a more immediate understanding of the importance of one's own emissions beyond transportation. Though rare, a few students noted this failure to connect, even while in a class on sustainable development. One student reported that

> *I spoke to a classmate that was tracking down her food also, and she told me that she didn't feel guilty … because she was not physically seeing any damages on her part of her carbon dioxide emissions.*

Along similar lines, another wrote:

> *Although, recording my results everyday; it ultimately didn't affect my choice of not eating a certain foods. I believe that this is because I can't see the effects in hand.*

On a similar note several students reported a sense of futility, a lack of agency. One wrote "*But what can I do? For I am just one person, would me changing my diet really make a change in the world? Sometimes I feel it's a lost cause for the atmosphere.*" Another expressed resignation: "*let's be real here, no one is going to consume less because we are all selfish and enjoy the wonderful delights of food.*" Of our collective future, one student wrote: "*Will they see the same beauty in nature as we do today, or will the catastrophic effects already have begun? I just don't know what to do anymore.*" While poignant, these sentiments were not in the majority.

Consistent with the plan of the class, more often students responded to feelings of futility with new understandings of personal agency. For example: "*This tracking system … makes you realize how you as a single person on earth can make a huge impact.*" Often students associated the personal agency gained through their new awareness of food carbon to a hopeful systemic scale:

> *… from this assignment I gained not only awareness of my own carbon footprint, but applied it to a larger, national scale. If American's become educated and aware of what living a sustainably entails, it may be possible to significantly cut emissions.*

Several others explicitly called for systemic cultural change:

> *positive shifts in consumption patterns on a large scale are more likely to work if institutional, systemic and cultural mechanisms are in place which make the right choice an easy one [for individuals] to make*", and "*The way we currently produce food needs a drastic change if we want to continue to live on Earth.*"

A number of students also reported satisfaction with the activity and what they were able to teach themselves. Comments included: "*I am learning more about carbon emissions through this experiment than I would've any other way*" and "*I never realized until this activity that if I changed my diet I could make the world a little better and create a better atmosphere*". As with the other activities, many students also commented on the wider meaning of the exercise: "*I believe the significants from this assignment doesn't just come from selfawareness and change, but rather the effect of this class (I included) spreading awareness to others*", and

> *If everyone did a carbon log for their food they would realize just how much carbon is emitted and then hopefully people would want to change eating habits. This tracker was the next best step that I could think of other than our earth dying in front of us.*

This self-learning is among the central goals of these exercises. Several students wrote of insights gained into important course concepts through the activities:

> *I realized that I was perpetuating one of the problems I had studied: externalities. … that simply because … I had not documented my diet's carbon output, that carbon simply ceased to exist altogether.*

Such experiences were hardly universal, but as the numerical analysis in the previous section indicates, both the food and the transportation CO_2e trackers proved valuable modes of learning for most students

Economic exclusion does pose one concern here. Several students reported that their income kept them from being able to lower their food CO_2e emissions. Several comments are represented by: "*I'm thinking from a poor college perspective here and when I buy food/meats, I buy the cheapest I can find. Free range and grass fed meats are just to expensive for me to buy*". This statements and others like them suggest that some explicit address of lower cost modes of food CO_2e reductions is in order.

Conclusion:

Clearly, these student-centered activities increased student awareness of sustainable practices and of the ramifications of their daily acts. The question that troubles any conclusions asks of actual changes in behavior. Many students did change their food choices away from higher to lower CO2e entrees. Also, combining similarly themed activities such as the public transit experience with the transportation carbon tracker does seem to offer learning synergies. A fifteen week class may not allow enough time for students to make changes in transportation choices, nor a sufficient period to evaluate any changes. In an effort to address this issue I plan to introduce the transportation and food CO_2e tracking to an upper division class so that they will track emissions for two weeks at the beginning of the fifteen week course and for two weeks at the end of the course. This will allow ten weeks for students to affect changes should they chose.

In student evaluations of the course, comments about the learner-centered activities were overwhelmingly positive. Students enjoyed the opportunity to learn on their own outside of the classroom. They also liked the decreased weight on exams in lieu of these activities. As an instructor, managing the submissions was not onerous, taking as little as five hours to download each activity's submissions, record their completion, and notify students of irregularities (mostly file format changes moving from PC to OS operating systems).

Furthermore, this study helps to identify areas of weakness in campus sustainability efforts and suggests ways to address those. Students commented on a paucity information regarding the carbon footprint of foods as well as low carbon foods available at our central food services venue. The shift away from bicycles and towards cars suggests fertile ground for a student led "bicycle to and on campus" campaign – a large portion of students live within two miles of campus across a very level and generally sunny suburban terrain crisscrossed with bike paths and bike lanes, a very bike-friendly environment.

In short, these activities work: as self-learning tools, as a way to increase student engagement with the class and with more sustainable practices, and as a way to decrease the ecological footprint of the student body and ultimately of the University itself.

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